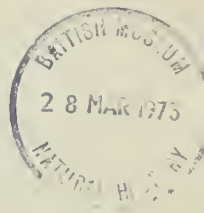


SOME BRITISH CRETACEOUS GASTROPODS
BELONGING TO THE FAMILIES
PROCERITHIIDAE, CERITHIIDAE AND
CERITHIOPSIDAE (CERITHIACEA)



BY

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By H. L. ABBASS

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LIST OF GENERA AND SPECIES

Family **PROCERITHIIDAE**

Genus *Nerineopsis* Cossmann, 1906

N. claxbiensis sp. nov.

N. aculeatum (Sharman & Newton)

N. subattenuatum d'Orbigny

N. coxi sp. nov.

N. melburiensis sp. nov.

N. cuckhamliensis (Woods)

N. adeli sp. nov.

Genus *Cirsocerithium* Cossmann, 1906

? *C. kirkaldyi* sp. nov.

C. subspinosum (Deshayes)

? *C. nooryi* sp. nov.

Genus *Nudivagus* Wade, 1917

N. morrissi sp. nov.

Genus *Bathraspira* Cossmann, 1906

B. tecta (d'Orbigny)

B. shanklinensis sp. nov.

B. clevelyi sp. nov.

B. brightoni sp. nov.

Genus *Metacerithium* Cossmann, 1906

M. trimonile (Michelin)

M. ornatissimum (Deshayes)

M. turriculatum (Forbes)

M. sp. nov.

Genus *Cimolithium* Cossmann, 1906

C. ascheri Wollemaann

C. aff. eleanorae Allison

Genus ? *Rhabdocolpus* Cossmann, 1906

? *Rhabdocolpus* ? *clementinum* (d'Orb.)

? *Rhabdocolpus forbesianum* (d'Orbigny)

? *Rhabdocolpus melvillei* sp. nov.

Family ? **PROCERITHIIDAE**

Genus *Uchauxia* Cossmann, 1906

U. wisei sp. nov.

U. badri sp. nov.

U. sp. nov.

Family **CERITHIIDAE**

Genus ? *Campanile* Bayle, 1884

C. cenomanica sp. nov.

Genus *Exechocirsus* Cossmann, 1906

E. saundersi (Woods)

E. aff. subpustulosus Pčhelincev

Family ? **CERITHIIDAE**

Genus *Ageria* nov.

A. gaultina sp. nov.

A. costata (J. de C. Sowerby)

Family **CERITHIOPSIDAE**

Genus *Cerithiella* Verrill, 1882

C. devonica sp. nov.

C. atherfieldensis sp. nov.

Genus *Seila* Adams, 1861

S. iglali sp. nov.

Genus *Orthochetus* Cossmann, 1889

O. hantoniensis sp. nov.

? *O. helmyi* sp. nov.

? *Orthochetus* sp. nov.

SYNOPSIS

Cretaceous Cerithiacea are described from principally two formations, the Crackers Bed in the Lower Greensand (Aptian) and the Gault Clay (Albian), comprising 14 genera and 38 species (23 of which are new). A new genus *Ageria* is erected and is provisionally included in the Cerithiidae. Aspects of the phylogeny of the Cerithiacea are discussed.

I. INTRODUCTION

THIS paper is the second resulting from a study of British Cretaceous gastropods, and is a revision of part of the work undertaken at Imperial College, University of London, during 1954–1956 for the degree of Ph. D. The families Procerithiidae, Cerithiidae and Cerithiopsidae (superfamily Cerithiacea) are sparsely represented in the British Cretaceous. Cox (1960) has recorded the limited literature describing British gastropods of this age. Most of the material described in this paper comes from old collections now in the major museums. Unfortunately, in many cases, nothing is known of the precise horizons and localities from which the specimens were collected, and some of the exposures no longer exist. Moreover, the specimens come from relatively few localities; 57% of the total of 62 Aptian specimens come from exposures on the Isle of Wight and of these, 52 were found at Atherfield, and include 39 from the Lower Greensand, Crackers Bed, exposed at that locality. Similarly, 82% of Albian material comes from Folkestone, Kent, and 11% from Blackdown, Devon.

Sixteen of the 38 species described are only represented by single specimens and this is ample evidence of the scarcity of such fossils. In only eight cases are specimens of the same species recorded for more than one locality; three examples are *Metacerithium turriculatum*, *Exechocirsus saundersi* and *Nerineopsis cuckhamliensis*.

This sparsity of the gastropod fauna reflects the aragonite composition of their shells (see Kennedy, 1969 : 462–465). They are most prolific where the shells have become silicified as at Blackdown, Devon; or where they have been preserved in hard rock bands ('Hard grounds') such as the Chalk Rock (see Wood, 1969 : 44 & 49–50); or in concretions, e.g. the Crackers Bed, I.O.W.; or in ironstone nodules such as those of Groups 14 & 15 of the Ferruginous Sands, I.O.W.

In an earlier paper (Abbass, 1961), I attempted to review the origin of the families discussed here and also to evaluate the significance of morphological and ornamental characters in their development. Although the present paper reveals numerous problems in classifying these Cretaceous fossils, it is hoped that it makes some contribution towards the documentation of Mesozoic gastropods that Sohl (1968: 1364) regards as a necessary preliminary to the more sophisticated analysis of the Class at this period. Once the rudimentary data is available, the stratigraphical use of gastropods that he envisages may be realized. His own work, showing the use of ornament changes in the Aporrhaidae (1960) and his recognition of the delineation of faunal provinces from the distribution of North American gastropods (1969), illustrates such potential usage.

II. ACKNOWLEDGMENTS

The author received considerable help and advice from the late Dr. L. R. Cox of the British Museum (Natural History) and from Prof. D. V. Ager of the University of Swansea, when he was at Imperial College and is especially grateful to them. The material examined forms part of the collections in the Department of Palaeontology of the British Museum (Natural History), the Geological Survey of Great Britain

and the Sedgwick Museum, Cambridge. The writer tenders his thanks to the authorities of these institutions for the facilities afforded him while carrying out his study. Thanks are also due to Mr C. W. Wright for allowing his collection to be examined at a time before it was presented to the British Museum (Natural History); and to Mr M. Durkin for the use of his Lower Cretaceous material. Finally, the author wishes to record that he is very deeply indebted to Dr N. J. Morris and Mr R. J. Cleavelly for their considerable efforts in revising and preparing the original manuscript for publication.

The latter, in turn, would like to record their gratitude to the various institutions mentioned above for further loans of material and also to Dr S. Ritzkowski of the Geologisch-Paleontologisches Institut in Göttingen for the loan of type material. They would also like to thank the staff of the Photographic studio of the BM(NH), particularly Messrs P. Green, T. Parmenter & Mrs. Tordis Walker, for their patience and considerable efforts to provide photographs of difficult material.

III. THE STRATIGRAPHICAL DISTRIBUTION OF THE SPECIES DESCRIBED

SENONIAN. The Upper Chalk has yielded a single specimen, *Nerineopsis adeli* sp. nov. from the Campanian, Springbank, nr. Coagh, Co. Derry, Northern Ireland.

TURONIAN. The Chalk Rock, at the base of the *Holaster planus* Zone, has provided a number of specimens of *Exechocirsus saundersi* (Woods): Missenden and Hitchin, Herts.; Medmenham and Latimer, Bucks.; Kensworth Quarry, Beds.; Cuckhamsley, Wilts. The last locality has also yielded *Nerineopsis cuckhamsliensis* (Woods).

CENOMANIAN. *Schloenbachia varians* Zone: *Metacerithium ornatissimum* (Deshayes) [Berks. and Bucks.].

Cenomanian (zonal details not known): ?*Cirsocerithium nooryi* sp. nov. (Ditchling, Sussex); *Cimolithium* aff. *eleanorae* Allison, (Charlton Bay, Devon); ?*Campanile cenomanica* sp. nov. [Devon]; *Nerineopsis melburiensis* sp. nov. (nr. Shaftesbury, Dorset); *Metacerithium ornatissimum* (Desh.), (Hamsey, Sussex and Burham and Dover, Kent).

ALBIAN. Upper Albian: *Seila iglali* sp. nov. (nr. Honiton, Devon); *Exechocirsus* aff. *subpustulosus* Pchelincev (Haldon, Devon); *Ageria costata* (J. de C. Sowerby) (Peak Hill, nr. Sidmouth, Devon); *Ageria gaultina* sp. nov. (Osmington, Dorset).

Upper Greensand, Blackdown, Devon: *Bathraspira ?brightoni* sp. nov.; *Cerithiella devonica* sp. nov., *Ageria costata* (J. de C. Sow.); *Uchauxia badri* sp. nov.

Gault Clay, Folkestone, Kent: Bed 1 (vii) intermedius Sub-zone, *Nerineopsis coxi* sp. nov.; horizon unrecorded, *Cirsocerithium subspinosum* (Deshayes), *Bathraspira tecta* (d'Orbigny), *Bathraspira fouadi* sp. nov., *Bathraspira brightoni* sp. nov., *Nerineopsis coxi* sp. nov., *Metacerithium trimonile* (Michelin), *Metacerithium?* sp. nov., *Uchauxia* sp. nov., ?*Orthochetus helmyi* sp. nov., *Ageria gaultina* sp. nov.

Lower Albian, Leymeriella regularis Subzone of the *L. tardefurcata* Zone: *Bathraspira tecta* (d'Orbigny) (Leighton Buzzard), *Bathraspira cleavellyi* sp. nov. (? Wrotham or Leighton Buzzard).

APTIAN. Upper Aptian, Ferruginous Sands, Parahoplites nutfieldensis Zone, Isle

of Wight: *Bathraspira shanklinensis* sp. nov. (Shanklin and Sandown), *Nudivagus morrisi* sp. nov., *Cirsocerithium kirkaldyi* sp. nov.

Lower Aptian, Deshayesites callidiscus Subzone of D. forbesi Zone; Crackers Bed, Atherfield, Isle of Wight: ?*Rhabdocolpus clementinum* (d'Orbigny), ?*Rhabdocolpus forbesianum* (d'Orb.), ?*R. melvillei* sp. nov., *Metacerithium turriculatum* (Forbes) *Cerithiella atherfieldensis* sp. nov., *Nerineopsis subattenuatum* (d'Orb.).

Lower Aptian, Deshayesites kiliani Subzone of D. forbesi Zone, Lower Lobster Bed: ?*Rhabdocolpus clementinum* (d'Orb.) (Atherfield, Isle of Wight).

Lower Aptian, Deshayesites forbesi Zone: *Metacerithium turriculatum* (Forbes) [Surrey and Kent].

Lower Aptian, Atherfield Clay Series: ?*Rhabdocolpus forbesianum* (d'Orb.), *Metacerithium turriculatum* (Forbes) [Surrey].

Lower Aptian, Atherfield, Isle of Wight: *Orthochetus hantoniensis* sp. nov.

NEOCOMIAN. Speeton Clay, Beds C6 to C8 (Hauterivian): *Nerineopsis aculeatum* (Sharman & Newton).

Speeton Clay, Beds D1 to B (Valanginian—Berriasian/Barremian): *Cimolithium ascheri* (Wollemann).

Claxby Ironstone and Claxby Beds (Valanginian—Hauterivian): *Uchauxia wisei* sp. nov. (Nettleton, Lincs.), *Nerineopsis claxbiensis* sp. nov.

IV. CHANGES IN GENERIC OR SPECIFIC ASSIGNMENTS

The following are the changes in generic or specific assignments of previously described species mentioned in the text.

Old assignment	New assignment
<i>Cerithium aculeatum</i> Forbes, 1845 . . .	<i>Nerineopsis aculeatum</i> (Sharman & Newton)
<i>Cerithium attenuatum</i> Forbes, 1845 . . .	<i>Nerineopsis</i>
<i>Cerithium gottfriedi</i> Wollemann, 1900 . . .	<i>Nerineopsis</i>
<i>Cerithium frickei</i> , Wollemann, 1906 . . .	<i>Nerineopsis</i>
<i>Cerithium cuckhamliense</i> Woods, 1896 . . .	<i>Nerineopsis</i>
<i>Cerithium turriculatum</i> Forbes, 1845 . . .	<i>Metacerithium</i>
<i>Cerithium mosense</i> Buvignier, 1852 . . .	<i>Metacerithium ornatissimum</i> (Desh.)
<i>Cerithium delpeyae</i> Collignon, 1949. . . .	<i>Metacerithium</i>
<i>Cerithium ascheri</i> Wollemann, 1908 . . .	<i>Cimolithium</i>
<i>Cerithium sanctaecrucis</i> Pictet & Campiche, 1864	<i>Cimolithium</i>
<i>Cerithium terebroides</i> d'Orbigny, 1842 . . .	? <i>Cimolithium</i>
<i>Cerithium ricordeanum</i> Cotteau, 1854 . . .	? <i>Cimolithium</i>
<i>Cerithium inauguralum</i> , Stoliczka, 1867 . . .	? <i>Campanile</i>
<i>Cerithium hispidulum</i> Stoliczka, 1867 . . .	not <i>Cimolithium</i>
<i>Cerithium gallicum</i> d'Orbigny, 1843 . . .	not <i>Cimolithium</i>
<i>Cerithium clementinum</i> d'Orbigny, Forbes, 1845	? <i>Rhabdocolpus</i>
<i>Cerithium forbesianum</i> d'Orbigny, 1850 = <i>Uchauxia forbesiana</i> (d'Orbigny) Cossmann	? <i>Rhabdocolpus</i>

<i>Cerithium phillipsi</i> Leymerie, 1842 . . .	<i>Uchauxia</i>
<i>Cerithium saundersi</i> Woods, 1896 . . .	<i>Exechocirsus</i>
<i>Cerithium pustulosum</i> d'Orbigny 1843 (non Sowerby).	<i>Exechocirsus</i>
<i>Cerithium navasi</i> Vidal, 1917.	<i>Exechocirsus</i>
<i>Turritella costata</i> J. de C. Sowerby, 1827. . .	<i>Ageria</i>
<i>Cerithium binodosum</i> Roemer, in Frič, 1894 .	<i>Ageria</i>
<i>Turritella angustata</i> d'Orbigny, 1850 . . .	? <i>Ageria</i>
<i>Cerithium hector</i> d'Orbigny, 1850 in Guéranger, 1867	? <i>Ageria</i>
<i>Tympanotonus</i> (<i>Exechocirsus</i>)	<i>Exechocirsus</i>
<i>Procerithium</i> (<i>Rhabdocolpus</i>)	<i>Rhabdocolpus</i>

V. SYSTEMATIC DESCRIPTIONS

Class *GASTROPODA*Subclass *PROSOBRANCHIA*Superfamily **CERITHIACEA**Family **PROCERITHIIDAE**

Haas (1953 : 212) has shown that the accepted subdivisions of this family, i.e. Cossmann (1906) and Wenz (1940) do not represent the true phylogenetic relationships within the group. He pointed out that the close similarity of *Protofusus* Bonarelli, *Paracerithium* Cossmann and *Rhabdocolpus* Cossmann conflicted with their being members of different subfamilies. Before their correct affinities can be determined, it is necessary to investigate Triassic faunas in more detail.

In this paper, the genera of the Procerithiidae are not divided into subfamilies. Cretaceous species of the following genera are described: *Nerineopsis*, *Nudivagus*, ?*Rhabdocolpus*, *Cirsocerithium*, *Bathraspira*, *Metacerithium* and *Cimolithium*. *Uchauxia*, Cossmann, 1906 was originally included in the subfamily Metacerithinae, but it is pointed out below (p. 146) that the true position of this genus is dependent on the apertural shape of its type species *U. peregrinorsa* and until this has been ascertained, its inclusion in the Procerithiidae remains provisional.

While describing the British Cretaceous members of this family, the difficulties experienced in assigning species to particular genera revealed the limitations of existing diagnostic characters of ornament, aperture, suture and whorl shape in distinguishing the various forms. These inherent problems underline the need for a modern revision of the family.

Genus **NERINEOPSIS** Cossmann, 1906

TYPE SPECIES. By original designation, *Cerithium davoustianum* Cotteau, 1854.

REMARKS. It is necessary to rely on Cossmann's interpretation of the type species *N. davoustiana* (Cotteau) for the diagnostic characters of the genus, as this species is seldom represented in collections. Peron's figure (Peron, 1902, pl. 4, fig. 6) is rather

stylized and does not show the ornament change between early and late whorls that is apparent from Cossmann's figure (1906: pl. 6, figs 9-11). Many of the species referred here to *Nerineopsis* are extremely small and this could be a reason for the poor representation of the genus in collections.

There is considerable variation in ornament both within the genus and within the species, but owing to the limited amount of material available it is not possible to evaluate the importance of this.

The three Upper Cretaceous species that are assigned below to this genus: *melburiensis* (Cenomanian); *cuckhamshiensis* (Turonian) and *adeli* (Campanian), are all very large in comparison to the normal size attained by *Nerineopsis*. Yet any suggestion, that the dimensions of such species may indicate a general increase in size within the genus at this time, is not supported by the other Upper Cretaceous examples listed by Cossmann (1906: 35) in his original description of the genus, e.g. *C. sarthacense* d'Orbigny (Cenomanian) and *C. chargense* Quaas (1902, pl. 26, fig. 25) (given as Danian but now recognised as Maastrichtian), for both are quite small. However, the resemblance of these larger gastropods, in shell form, whorl outline and ornament to *Nerineopsis*, indicates that they are probably congeneric.

***Nerineopsis claxbiensis* sp. nov.**

(Pl. 1, fig. 13)

DIAGNOSIS. Slender, turriculate shell; ornament of three smooth spiral cords on adapical half of whorl, and smooth lower half and an abapical carina.

MATERIAL. BM(NH) GG 5612, C. W. Wright collection, Claxby Beds, Valanginian to Hauterivian, Nettleton, Lincolnshire.

DESCRIPTION. Small, turriculate shell, with narrow spire. Moderately deep linear suture. Whorls very slightly concave in outline with an anterior carina.

Early whorls ornamented by four smooth spiral cords. The anterior one is the most prominent and on later whorls this develops into a smooth anterior carina. Two spiral cords occur close to the adapical part of the whorl and these are separated by an interspace almost equal to their width. The third cord occurs towards the centre of the whorl side, while the area between this and the abapical carina is without ornament of any kind. On the last whorl it is possible to see that an astragal occurs below the carina and that this delimits the somewhat flattish base. The aperture is quadrangular and has a short, twisted anterior canal.

DIMENSIONS. Holotype, BM(NH) GG 5612.

Height (15 whorls)	. . . . .	11.3 mm
Spiral angle	. . . . .	16°
Penultimate whorl height (between sutures)	. . . . .	1.2 mm
Penultimate whorl diameter	. . . . .	3.0 mm

DISCUSSION. This species is distinguished from the Lower Aptian *N. subattenuatum* (d'Orbigny) by the absence of an adapical astragal, and from *N. davoustiana* (Cotteau) in the lack of a median tuberculate spiral cord.

Nerineopsis aculeatum (Sharman & Newton), 1896

(Pl. 1, figs 5-8)

1896 *Cerithium aculeatum* Forbes MS, Sharman and Newton: 250.1961 '*Cerithium*' *aculeatum* Forbes: Casey: 608.

LECTOTYPE. BM(NH) G 55222 designated here.

PARALECTOTYPES. BM(NH) G 55191-55192; G 55218 & 55219 on the same specimen; G 55220; and G 55223-55228. All these specimens are from the G. W. Lamplugh collection, Speeton Clay, zones C 6-8, Hauterivian. Speeton, Yorks.

OTHER MATERIAL. All from the Speeton Clay, Speeton, York. BM(NH) 64121 (3 specimens); 64144 (2 specimens) and 64155, purchased from Lady Hastings, 1855; BM(NH) GG 20789, C. W. Wright collection; Geological Survey Museum 93749.

DESCRIPTION. Small, turreted shell with two strong carinae. Narrow, linear suture, slightly grooved.

The adapical carina, with a strong spiral cord, occurs below the posterior suture and gives rise to a small concave shoulder. The second carina is situated in the centre of the whorl, while there is a third, weaker, carina towards the abapical suture, which tends to mark the periphery of a flat, very slightly convex base. The interspaces between the carinae are occupied by weaker secondary spiral cords; two to three between the adapical and median carinae and one between the median and abapical carinae. The base is ornamented by smooth spiral cords that vary in number and extend on to the columella.

Axial ribs begin at the adapical suture, but, in most cases (e.g. G 55192), these only reach the second, or third spiral cord. The tubercles that develop at the junctions of ribs and cords, contribute to the frilled appearance of the adapical carina. Sometimes the ribs persist and result in a reticulate ornament (e.g. G 55223). It was only possible to count the ribs on two specimens; G 55220 with 24 per whorl and one of the specimens numbered 64144 has 21 per whorl. These so-called 'ribs' (see Sharman & Newton) tend to follow the opisthocline growth lines and it is virtually these growth lines that cause the frilling of the adapical carina. The aperture is seldom preserved sufficiently for adequate description, but would appear to be sub-circular with a short, curved anterior canal.

The variability of ornament in specimens of *N. aculeatum* is quite noticeable, principally occurring in the differing number and arrangement of the weaker spiral cords, but occasionally in the position of the stronger cords and consequently the carinae. In particular, BM(NH) GG 55220 has a strong median carina, whereas the carinae are of equal strength.

DISCUSSION. Although the name *Cerithium aculeatum* was used by Judd (1868: 235, 242) and Lamplugh (1889: 598) the species was not described or figured by either author, and therefore these references must be considered as *nomina nuda*. Sharman and Newton (1896) were the first to provide an adequate description of this species. However, it was not figured, for their principal concern was to provide an account of a mould found in drift material at Moreseat, near Aberdeen, and which

they considered to be a variety of *C. aculeatum*. The specific name has, in the past, been attributed to Forbes, because he attached the name to specimens found in the Speeton Clay.

Sharman and Newton (1896 : 248) mention their consultation with Lamplugh and the fact that they were able to compare the Moreseat mould with his large series of Speeton fossils. It is on this evidence that the Lamplugh material in the BM(NH) collections has been considered as a type series. It was difficult to select a lectotype, since these specimens are either incomplete, or poorly preserved. The best specimen consists only of the earlier whorls, and these do not show the full ornament development.

It should be pointed out that the record of the use of the name *Cerithium aculeatum* (Gmelin) given by Oken (1815 *Lehrbuch Nat.*, iii, 1 : 268) refers to a Recent species, *Potamides* (*Tympanotonus*) *radula* (Linn.) see Tryon (1887, Vol. 9: 159), which Gmelin (1790 in the 13th edition of *Linn. Syst. Nat.* : 3523) recorded as *Strombus*. The International Commission of Zoological Nomenclature have decided to place Oken's book on the list of rejected works (Opinion 417, 1956).

The turreted form of *N. aculeatum* (Gmelin) together with the presence of three carinae, of which two virtually form a bicarinate keel towards the base of the whorl, easily distinguish it from the nerineiform *N. attenuatum* (Forbes) with only adapical and abapical carinae. *Cerithium gottfriedi* Wollemaann (1900 : 168, pl. 8, fig. 7) from the Neocomian of Brunswick, Germany, has strongly similar ornament to *N. aculeatum*, but can be separated by the presence of projecting thorn-like tubercles on the uppermost spiral cord, its weak mid-whorl spirals and the much weaker development of axial ribbing.

Nerineopsis subattenuatum (d'Orbigny), 1850

(Pl. 1, figs 9 & 12)

1845 *Cerithium attenuatum* Forbes: 352, pl. 4, fig. 11.

1850 *Cerithium subattenuatum* d'Orbigny: 116.

DIAGNOSIS. *Nerineopsis* with adapical and abapical beaded astragals with five to seven spiral cords between them; suture grooved.

MATERIAL. Holotype, in Geological Survey Museum, ex-Geological Society collection, No. 2274, from the Lower Greensand, Atherfield, Isle of Wight. Other material includes Geol. Survey Museum no. 93687 and possibly BM(NH) GG 5610, both from the Crackers Bed, Lower Aptian, Atherfield, Isle of Wight.

DESCRIPTION. Small, slender, nerineiform shell with a slightly concave whorl outline. The suture lies in a furrow formed by the astragals on the adjacent whorls. The width of this furrow is equal to half the height of the whorl. The whorl is ornamented by two similar and faintly beaded astragals, one near each suture, with the spaces between their beads almost equal to the width of a bead. These astragals are separated by a wide area, that is three to four times the width of an astragal, and which is ornamented by a small number of spiral cords that are not clearly preserved in either specimen. The base has a carinate border and a convex surface

crossed by spiral threads. The aperture is not preserved in any specimen, nor is there any indication of the growth lines.

DIMENSIONS. GSM 93687.

Height	18.0 mm
Spiral angle	approx. 14°
Penultimate whorl height	1.6 mm
Penultimate whorl diameter	3.7 mm

DISCUSSION. While attempting to identify these Crackers specimens, it was recognised that they have some affinity with Forbes' figure of *Cerithium attenuatum*. On investigating his specimen, (a very poor external impression preserved in a matrix of sandy-clay), the style of ornament confirmed this opinion. It is therefore possible to give a slightly more satisfactory description of this fossil and to point out that the central rib forming a sharp and prominent keel, which he described, is in fact formed by one of the astragals and that the lack of any indication of a suture on the specimen led him astray.

D'Orbigny (1850 : 72 & 116) introduced the name *C. subattenuatum* to replace *C. attenuatum* Forbes, after he had included the Wealden fossil, *Melanopsis attenuatum* J. de C. Sowerby (1836 in Fitton, pl. 22) in the genus *Cerithium*. This rendered *C. attenuatum* Forbes a secondary homonym (see Article 57 and 59b) and although *Melanopsis attenuatum* would now appear to be a Cassiope, or a closely-related form, Forbes' specific name cannot be restored (see Article 57c, Int. Code of Zool. Nomen), as the name had been rejected before 1960.

D'Orbigny's species is similar to *Nerineopsis davoustiana* (Cotteau), 1854 in shell and whorl shape, but in *davoustiana* the abapical astragal is smooth, while *N. subattenuatum* has markedly grooved sutures and a more concave whorl outline. *Cerithium frickei* Wollemaann (1906 : 292, pl. 10, fig. 5) is thought to have a more prominent tuberculate abapical spiral cord, but it is impossible to make any further comparison from Wollemaann's figure.

Nerineopsis coxi sp. nov.

(Pl. 1, figs 10 & 11)

DIAGNOSIS. Slender turriculate shell, ornamented by three strongly tuberculate spiral cords of which the abapical row is the most prominent.

HOLOTYPE. BM(NH) GG 6475, Gault, Folkestone, Kent.

PARATYPES. BM(NH) GG 6474, G 73787, G 7411, G 4363 (24 specimens), Middle to Upper Albian, Gault, Folkestone, J. S. Gardner collection; BM(NH) 41731 (3 specimens); and GG 20786-20788, Albian, Lower Gault, Bed 1 (vii), East Cliff, Folkestone, collected by Messrs N. J. Morris, J. D. Taylor and R. J. Clevely.

DESCRIPTION. A small, slender, turriculate shell, with a finely-channelled suture. The whorl outline is a little concave on either side of a subcentral carina. A protoconch is not available, but the first preserved whorl is smooth and convex, while a smooth spiral cord appears on the second whorl, this is followed by another spiral cord adapical to the first giving the third whorl a bicarinate outline. The

opisthocline growth lines then become apparent and it is also possible to discern a further smooth spiral cord at the abapical suture. At the sixth preserved whorl, the adapical cord becomes a line of tubercles, while the appearance of small axial ribs accentuates the growth lines. The ribs extend from the adapical suture to the abapical cord and enlarge these tubercles. At the 'seventh' whorl, tubercles also appear on the abapical cord and this gradually becomes the strongest and sub-carinate. At this stage, the tubercles on this cord are quite strong, isolated and projecting slightly abapically. They, later, tend to merge into the cord, which nevertheless persists, giving rise to a carina that is only disturbed by small notches.

On the 'tenth' whorl, a fourth spiral cord develops close to the adapical suture, this soon becomes beaded and, in turn, becomes tuberculate. The number of tubercles per whorl on the stronger abapical carinate cord is about 12-14; on the adapical cord about 16-18 and on the fourth cord about 14-16.

On later whorls, a band of three closely spaced spiral threads occurs midway between the first-formed cords. The flat base is bordered by the third spiral cord described above. A slight spiral occurs at a short distance from the edge and faint traces of flexuous growth lines occur. The aperture is not completely preserved in any of the specimens, but a short, slightly curved, anterior canal is present.

DIMENSIONS. BM(NH) G 73787.

Height (15 whorls)	.	.	.	.	.	.	12.0 mm
Spire angle	.	.	.	.	.	.	12°
Last whorl height	.	.	.	.	.	.	1.5 mm
Last whorl diameter	.	.	.	.	.	.	3.5 mm

DISCUSSION. The distinctive ornament of this species separates it from all other described forms. The slightly sub-central carina, produced by its strongly tuberculate initial spiral cord, easily enables *N. coxi* to be distinguished from forms that have a concave whorl outline, e.g. *N. loryi* (Pictet & Campiche, 1862) and *N. subattenuatum* (d'Orbigny 1850). The three rows of tubercles also serve to differentiate the species from both *N. loryi*, which only has two rows of tubercles (or beads), between its adapical and abapical astragals; and also *C. rochati* Pictet & Renevier, 1854, which also has three tuberculate rows, but in different positions. Although *N. gottfriedi* (Wollemann, 1900) has a row of frilled tubercles, these are close to the adapical suture rather than central. The numerous additional spiral cords of *N. aculeatum* prevent any comparison with *N. coxi*, on account of its slightly frilled adapical carina. Cossmann (1906 : 35) included *Cerithium excavatum* Brongniart, 1822 in his list of *Nerineopsis*, yet without examining actual specimens it is not possible to offer any worthwhile comment on that species. Its concave whorl shape and ornament of a smooth abapical astragal and tuberculate adapical cord would appear to be reasonable features upon which to distinguish this Albian fossil from *N. coxi*.

Nerineopsis melburiensis sp. nov.

(Pl. I, figs 1 & 2)

DIAGNOSIS. Large *Nerineopsis* with only faint abapical and adapical astragals and fine spiral cords; suture slightly grooved.

HOLOTYPE. GSM 93752, the only known specimen.

LOCALITY AND HORIZON. Chloritic Marl, Lower Cenomanian, Melbury Park, nr. Shaftesbury, Dorset.

DESCRIPTION. Nerineiform shell of medium size. The whorl outline is feebly concave with narrow convex margins. The linear suture lies in a furrow bordered by the astragals of adjacent whorls. The width of the furrow is equal to about one-fifth to one-quarter of the height of the whorl. The whole surface, including the two astragals, is crossed by about 20 or more spiral threads, which are separated by interspaces equal to their own width. These threads are unequal in strength and show collabral rugae at intervals.

The base has a rounded edge, within which the surface is convex and crossed by growth-lines and spiral threads. The aperture is small and rhomboidal with an outer lip that has a parasigmoidal outline. The columella is smooth and short. The growth-lines show a moderately deep sinus.

DIMENSIONS. Holotype (GSM 93752)

Height (incomplete 6 whorls)	. . . . .	20.0 mm
Spire angle . . . . .	. . . . .	11°
Penultimate whorl height (between sutures)	. . . . .	3.5 mm
Penultimate whorl diameter . . . . .	. . . . .	3.6 mm

DISCUSSION. This single specimen differs from other known species of *Nerineopsis* principally in its larger size, but also in the smoothness of its astragals and in the greater number of spirals between them. On comparison with the other large Upper Cretaceous forms assigned to *Nerineopsis* in this paper, it is more elongate and slender than either *N. cuckhamliensis* or *N. adeli*, while its two astragals appear to be stronger than those of the former.

Nerineopsis cuckhamliensis (Woods)

(Pl. I, figs 3 & 4)

1896 *Cerithium cuckhamliense* Woods: 92, pl. 4, fig. 11.

HOLOTYPE. Sedgwick Museum B 4443, from the Chalk Rock of Cuckhamsley, Wilts.

OTHER MATERIAL. The only other specimens available are from the Chalk Rock, Holaster planus zone, Turonian, of Hill End, Hitchin, Herts. (BM(NH)G 48978) and Marlow, Bucks. (BM(NH) GG 6286). Woods (1896) also records material from Luton, Beds.

DESCRIPTION. A medium-sized conical shell in which the flat whorl outline is slightly concave before a low abapical carina. The suture is linear and grooved. This groove is bounded posteriorly by the low abapical carina and anteriorly by a rounded, less prominent, adapical shoulder, which gives rise to the slightly pagodiform outline. The apical whorls are not preserved.

Very faint spiral striae are just visible on some whorls. The aperture and base are imperfectly preserved on the material studied.

DIMENSIONS.

	Holotype SM B 4443	BM(NH) G 48978
Height	approx. 33.0 mm	approx. 26.0 mm
Spiral angle	19.5°	20°
Penultimate whorl height (between sutures)	3.5 mm	3.9 mm
Penultimate whorl diameter	approx. 9.0 mm	9.4 mm

DISCUSSION. This species can be attributed to the genus *Nerineopsis* as its shell form, whorl outline and ornament resemble typical members of that genus.

The slender shape of *N. melburiensis* would appear to separate that species from *N. cuckhamliensis* and this difference is emphasized by the presence of both adapical and abapical astragals in the former. The strong spiral cords of the Campanian, *N. adeli* are in complete contrast to the very faint spiral threads that can just be distinguished on the poorly preserved examples of *cuckhamliensis*, while the faintly tuberculate adapical astragal of *N. adeli* is quite distinct from the rounded shoulder present in Wood's species.

Nerineopsis adeli sp. nov.

(Pl. I, fig. 14)

DIAGNOSIS. Large *Nerineopsis* with grooved suture, adapical tuberculate astragal and nearly smooth abapical astragal separated by six spiral cords.

HOLOTYPE. Unique specimen in the Geological Survey Museum, registered number 93753, the only specimen seen.

LOCALITY AND HORIZON. Upper Chalk, ? Campanian, Springbank, nr. Coagh, Co. Derry, Northern Ireland.

DESCRIPTION. The shell is of medium size and cylindrical. The whorl is low and its outline rather flat, or feebly convex. The suture occurs in a furrow bordered by the astragals of adjacent whorls and is of the same width as a primary spiral. There are two astragals, of which the posterior has faint tubercles that are separated by spaces equal to twice the tubercular width, while the anterior astragal is almost smooth. Both the astragals are double the width of a spiral cord and nearly equal to one another. The six spiral cords are separated by very narrow and unequal interspaces of half to one-third their width. The base has a rounded edge and a convex surface crossed by growth rugae and spiral threads. Small, rhomboid, aperture with an anteriorly protruding outer lip. Growth lines show a shallow sinus. Columella smooth.

DIMENSIONS. Holotype (GSM 93753)

Height (6 whorls)	. . . . .	28 mm
Spire angle	. . . . .	20°
Spire whorl height (between sutures)	. . . . .	4 mm
Spire whorl diameter	. . . . .	11 mm

DISCUSSION. The prominent ornament of this species, i.e. the strength of its six spiral cords, the slightly tuberculate appearance of the adapical astragal and its convex whorl outline, easily separate *N. adeli* from either of the other large Upper Cretaceous species described above.

Genus *CIRSOCERITHIUM* Cossmann, 1906

Type species by original designation, *Cerithium subspinosum* d'Orbigny, 1843 = *Cerithium subspinosum* Deshayes, 1842.

DIAGNOSIS. Small shells, of squat conical form, with strongly convex and sometimes angular whorls, forming a rather tier-like spire. The sutures are bordered by a spiral cord that is often granulose. Ornament consists of numerous spiral cords and a smaller number of axial ribs. Tubercles (or nodes) occur at the intersections, particularly on the upper part of the whorl and at the adapical shoulder. Last whorl relatively large, sometimes almost two-fifths of the total whorl height and it has a slight angularity at the base. Base feebly convex and ornamented by numerous spiral threads. Rounded aperture, not sinuous, and a short straight beak at its tip. Outer lip thickened with a strong external varix but this does not have internal lamellae. Columella strongly perpendicular. Parietal lip very straight and a little thickened. Partially, formed anterior canal.

REMARKS. Cossmann (1906) only compared his new genus with the similarly ornamented Tertiary *Hemicerithium* Cossmann, 1893. He distinguished them by apertural characters and pointed out that *Hemicerithium* has a definite, short, truncated canal and a visibly twisted columella, while *Cirsocerithium* has a simple beak and a columella that is not twisted at its anterior end, or modified by the beak. It is difficult to fully understand his finer points of distinction, even after a thorough comparison of the figures that he gave for both genera.

Cossmann also referred to the similarity of the columella and beak of *Cirsocerithium* and *Paracerithium* Cossmann, 1902, but separated them by using the columellar characters mentioned above. Such a distinction is also difficult to comprehend for in that feature they appear to be practically identical. However, the apertural varix present in *Cirsocerithium* and their different ornament provide sufficient criteria for distinguishing the two genera.

Nagao (1934 : 253) when describing *Cirsocerithium reticulatum* from the Aptian, Hiraiga Sandstone of Japan, stated that he regarded *Cirsocerithium* as a subgenus of *Cerithium*, but did not proceed to elaborate on his reasons. Presumably, his opinion is based on the interpretation of the short anterior canal, which he evidently considered was sufficiently 'cerithium-like' to warrant closer affinity with *Cerithium*. On the other hand, Cossmann regarded the canal as being rudimentary and therefore included the genus in the Procerithiidae.

Two of the British examples described here can only be tentatively referred to *Cirsocerithium* on the basis of common apertural and ornamental features. The prominent axial ribs of ?*Cirsocerithium kirkaldyi* sp. nov. are very like those occurring in the related genus *Paracerithium*, which is virtually confined to the Jurassic, for the

inclusion of the Neocomian species *C. gauthieri* Peron, 1899 in *Paracerithium* is extremely doubtful.

Cossmann's inclusion of the Cenomanian species *C. peroni* Cossmann, 1906 in *Cirsocerithium*, has prompted my decision to provisionally include ?*C. nooryi* sp. nov. in the same genus. Both species have a wide spiral angle producing broad shells, and possess a rounded aperture with an apertural varix, although their general ornament and whorl shapes are quite different.

***Cirsocerithium subspinosum* (Deshayes), 1842**

(Pl. 2, figs 1 & 2)

1842 *Cerithium subspinosum* Deshayes in Leymerie: 14, pl. 17, fig. 12.

1843 *Cerithium subspinosum* Deshayes; d'Orbigny: 364, pl. 229, figs. 4-6.

1903 *Cerithium subspinosum* Deshayes; Wollemaun: 32, pl. 4, fig. 11 & 11a.

1906 *Cerithium subspinosum* Deshayes; Wollemaun: 290, pl. 10, figs 2-3.

1906 *Cirsocerithium subspinosum* (d'Orb.) Cossmann: 51, pl. 7, figs 1-3.

1949 *Cerithium subspinosum* Deshayes; Collignon: 36, pl. 4, figs 14 & 15.

MATERIAL. Sedgwick Museum, B 32530 and BM(NH) GG 20746.

LOCALITY AND HORIZON. The Gault, Middle or Upper Albian, Folkestone, Kent; also recorded from Albian, Algermissen, Germany (fide Wollemaun); Albian, Ervy and Gerodot, Dept. of Aube, France (fide d'Orbigny); Albian, Ambarimaninga, Madagascar (fide Collignon).

DESCRIPTION. Small, subfusiform shell with a convex whorl outline and sub-sutural ramp. Except for the apical whorls, the suture is linear and grooved.

The first whorl is very small but the whorl size expands rapidly until the fourth whorl, the spiral angle for these initial whorls being approximately 75°. The first and second whorls are rounded and smooth. The third and fourth are angular, having a wide sutural ramp and a flat whorl side that is parallel to the axis but turns in again towards the axis at a second angularity just above the suture. (N.B. This description of the early whorls is based on GG 20746).

On the fifth whorl strong spiral cords have developed along the angularities. These cords are crossed by marked rugae which follow the growth lines. The rugae are strongly opisthocyr, or slightly opisthocline and are raised as they cross the adapical cord at the edge of the ramp. The sixth whorl has the typical ornament pattern of later whorls, with nine axial ridges per whorl. The axial ridges are tuberculate at the edge of the ramp and gradually taper abapically down the whorl side. Further spiral cords appear in the following positions: a third spiral is introduced on the seventh whorl between the ramp and the cord on the abapical angularity, while another develops on the eighth whorl. On the ninth, the final whorl, intermediate spirals appear between these, and a single cord on the ramp. A series of one strong and four fine spiral cords are present on the base below the abapical angularity.

DIMENSIONS.

	SM B 32530	BM(NH) GG 20746
Height	8.0 mm approx.	6.0 mm
Penultimate whorl height	1.5 mm	1.1 mm
Penultimate whorl diameter	3.3 mm	2.2 mm

DISCUSSION. The specimen in the Sedgwick Museum B 32530 (see pl. 2, fig. 1) closely resembles the illustration of Deshayes' holotype and other subsequently figured material. Specimen BM(NH) GG 20746 (pl. 2, fig. 2) differs slightly from these typical forms, in which the axial ridges nearly disappear on the body whorl, by having fewer spiral cords and rather more prominent axial ridges. In many respects, this more acutely-whorled form resembles *Cirsocerithium harborti* (Wollemann, 1908 : 179, pl. 13, figs 5-7) from the 'Upper Neocomian' but at present, it is considered to be a morphological variant of *C. subspinosum*.

? *Cirsocerithium kirkaldyi* sp. nov.

(Pl. 2, fig. 8)

DIAGNOSIS. A possible *Cirsocerithium* ornamented by high, sharply angular, axial ridges on the whorl side and possessing a distinct sutural ramp; the subsutural spiral cord lacks beaded ornament.

HOLOTYPE. BM(NH), GG 5603.

MATERIAL. The holotype and a single paratype BM(NH) GG 5604 originally in the C. W. Wright collection. Both shells are worn.

LOCALITY AND HORIZON. Ferruginous Sands, Lower Greensand, ? Nutfieldensis Zone, Aptian, Shanklin, Isle of Wight.

DESCRIPTION. A small subfusiform shell with a short spire. The convex whorls have a distinct sutural ramp and are separated by an undulating suture. The material studied lacks the apical whorls. The ornament of later whorls consists of eleven orthocline axial ridges per whorl, and these are separated by interspaces equal to their own width. The axials are slightly flattened in the middle, particularly at the edge of the ramp. On the paratype, there is an indefinite subsutural spiral cord and a further five primary spiral cords, the first being at the edge of the ramp and the fifth at the edge of the base. There are six to seven fine secondary spiral cords on the ramp, three between the first primary (at the edge of the ramp) and the next abapically, and one in each of the remaining interspaces. The base is ornamented by three fine spiral cords and an astragal occurs towards the columella. The latter is crossed by the ends of the axial ridges.

The available material does not show a well-preserved aperture and it is therefore impossible to determine whether or not an apertural varix is present. The growth lines are orthocline on the whorl side, but prosocline on the ramp and apparently prosocline on the base; these presumably represent a sinuously prosocline outer lip to the aperture, a feature which is not typical of *Cirsocerithium*.

DIMENSIONS. Holotype BM(NH) GG 5603

Height	.	.	.	.	.	approx.	10.5 mm
Spiral angle	.	.	.	.	.	.	27°
Height of last whorl	.	.	.	.	.	.	6.5 mm
Penultimate whorl diameter	.	.	.	.	.	.	5.5 mm

DISCUSSION. Although lacking the characteristic apertural varix of the genus and possibly having a sinuous outer lip, the remaining features of this species suggest an affinity with *Cirsocerithium*. ?*C. kirkaldyi* differs from both the type species *C. subspinosum* and *C. harborti* (Wollemann, 1908 : 179, pl. 13, figs 5-7), by not having beaded ornament on the subsutural spiral cord. In this way it resembles *C. aptiense* (d'Orbigny 1843 : 363-364, pl. 229, figs 1-3). It differs from all three species in having more prominent axials, particularly at the edges of the ramp. This ramp also appears to be flatter at approximately 45° to the axis, when compared with *C. aptiense* (40°) as figured by d'Orbigny. A further difference is that the edge of the ramp is relatively closer to the adapical suture in ?*C. kirkaldyi* than in *C. aptiense*.

Finally, the resemblance of ?*C. kirkaldyi* to the Jurassic genus *Paracerithium* in possessing very strong axial ribs and an adapical ramp, is repeated.

? *Cirsocerithium nooryi* sp. nov.

(Pl. 2, figs 3 & 4)

DIAGNOSIS. Conical littoriniform species with beaded spiral cords but no axial ridges and bearing an apertural varix.

HOLOTYPE. BM(NH) 98208. This unique shell is replaced by limonite and is slightly crushed.

LOCALITY AND HORIZON. Lower Chalk, Cenomanian, Ditchling, Sussex.

DESCRIPTION. Small to medium-sized shell, rather large for genus. Conical to littoriniform with a rounded periphery. Whorl outline slightly convex with a grooved suture. Aperture, broad, oval and oblique; outer lip has a shallow sinus and a rounded apertural varix; both inner and outer lips are smooth and reflected outwards.

Ornament consists of granulose (beaded) spiral cords. The initial whorls show four beaded primary spiral cords separated by interspaces nearly equal to their own width. Beads on successive spirals follow the opisthocyrt growth-line direction (i.e. they are slightly curved). On later whorls secondary beaded spirals appear and on the body whorl these may become as prominent as the primary cords. The adapical spiral cord is separated from the rest of the spirals by a slightly wider interspace. It forms a partial shoulder on which the preceding whorl rests. The convex base is not delimited from the whorl side and is crossed by almost smooth alternating primary and secondary spirals.

DIMENSIONS. Holotype BM(NH) 98208

Height	25 mm
Spiral angle	32°
Penultimate whorl height (between sutures)	4 mm
Penultimate whorl diameter	9 mm

DISCUSSION. This species is provisionally included in the genus *Cirsocerithium* principally on the basis of its rounded aperture and apertural varix, the opisthocyrt growth lines and the presence of a strong adapical subsutural spiral cord. Its broad shell and wide spiral angle resembles another Cenomanian species, *C. peroni* Cossmann

1906, which Cossmann included in his description of the genus. However, these two species differ in their general whorl shape and ornament. The weak development of the axial ornament, the flattish whorl sides, a smaller number of spirals and its rounded shell-shape immediately distinguish it from the type species *C. subspinosum* Deshayes.

Genus *NUDIVAGUS* Wade, 1917

Type species by original designation, *Nudivagus simplicius* Wade, 1917.

DIAGNOSIS. (after Sohl, 1960 : 79). Large turriculate shell, with numerous smooth, flat-sided whorls forming an evenly tapering spire; sutures deeply impressed; growth lines prosocline; aperture sub-ovate to sub-rhomboidal, anterior canal short and slightly curved, inner lip smooth, lightly callused columellar lip.

DISCUSSION. Sohl (1960) pointed out that the sub-ovate apertural outline, short curved anterior canal and the lack of a thick parietal wall callus, serve to distinguish the fusiform *Nudivagus* from *Gymnocerithium* Cossmann, but ally it to the Procerithiidae. Wade (1917) has shown that apertural and columellar features separate *Nudivagus* from other Cerithiacea which have some similarity in shape, e.g. *Clava* and *Cerithium*.

Nudivagus morrisi sp. nov.

(Pl. 2, figs 11 & 12)

DIAGNOSIS. *Nudivagus* with axial ribs occurring on all whorls, an angular basal edge and opisthocyrt growth lines.

MATERIAL AND OCCURRENCE. Geological Survey Museum 2252, an external mould from the Ferruginous Sands, (? Group XIV), Aptian, Nutfieldensis Zone, Shanklin, Isle of Wight.

DESCRIPTION. Medium-sized shell with an elongate fusiform spire. Whorl outline flat, or feebly convex. Simple impressed suture. The rounded earlier whorls show a large number of orthocline to opisthocyrt axial ribs. Ornament of later whorls consists of numerous very fine spiral threads that are crossed by equally fine opisthocyrt growth lines. The base of the whorl is slightly convex and has an angular margin. The aperture is incomplete, but would appear to be prolonged anteriorly into a short beak.

DISCUSSION. The whorl shape, impressed suture and relatively smooth shell with its ornament of fine spiral threads and growth lines, are very similar to the features of *Nudivagus simplicius* Wade (1917 : 297, pl. 19, figs 4 & 5) from the Upper Cretaceous Maastrichtian, Ripley Formation of Texas, U.S.A. It would appear to differ from that species, in having axial ribs on the rounded early whorls, a much sharper basal edge and opisthocyrt, rather than prosocline, growth lines. The strongly convex whorl outline of another American Maastrichtian species, *Nudivagus ?cooperensis* Stephenson, (1941, pl. 54, figs 11 & 12) precludes any comparison. *Cerithium (Fibula) detectum* Stoliczka (1868 : 192, pl. 15, fig. 1), a species with

strongly rounded whorls, and originally included in *Nudivagus* by Wade, would seem to require further investigation before it can be accepted as belonging to the genus.

At first sight, Casey's Cretaceous genus *Brightonella* appears to have some general similarity with *N. morrissi*, but on examining the holotype of *B. sandlingensis* Casey (1961: 591) it was possible to note several differences. *N. morrissi* has a much wider spiral angle, its growth lines are more chevron-like and the last whorl has a slight sub-sutural ramp that is not present in *Brightonella*. The holotype of *B. turris* Casey, the type species of the genus, a rather crushed specimen, and other examples in the collection of the Geological Survey Museum, appear to support these differences. The short anterior canal present in *Nudivagus* serves to distinguish it from the Pseudomelanidae, the family to which *Brightonella* has been assigned.

Genus **BATHRASPIRA** Cossmann 1906

Type species by original designation, *Bathraspira tecta* (d'Orbigny) 1842.

REMARKS. A number of authors have described new species since Cossmann erected this genus in 1906, with the result that this group is another in need of considerable revision. Unfortunately, no useful investigation can be undertaken with the very few specimens available, due, in part, to the lack of precise stratigraphical information. In order to assess the variation in both ornament and shape, interpret the species, to then decide the number of species present at a particular horizon, and ultimately to infer their phylogenetic relationships, it is necessary to obtain further well-localized material and to re-examine type material. Therefore, for the present, I have only attempted to describe the specimens present in museum collections in Britain and consider this to be a preliminary to the more detailed investigation of the genus. Regrettably this has led to the description of new species from single specimens. Existing British material is the result of meticulous collecting by and on behalf of J. S. Gardner in the past, and more recently by Mr C. W. Wright.

Despite the qualifications expressed above, it is possible to observe that there is a general tendency for ornament to increase in this genus of Cretaceous gastropods, progressing from the Aptian *B. shanklinensis* to the strongly ornamented Albian *B. brightoni*.

Finally, it should be mentioned that the lack of suitable material has prevented redescription of the species *B. neocomiensis* (d'Orbigny) 1843.

Bathraspira tecta (d'Orbigny), 1842

(Pl. 3, fig. 1)

1842 *Cerithium tectum* d'Orbigny: 368, pl. 230, figs 4-6.

1862 *Cerithium tectum* d'Orb.; Pictet & Campiche: 295, pl. 71, fig. 12 and p. 303.

1903 *Cerithium tectum* d'Orb.; Wollemand: 31, pl. 4, fig. 10.

1906 *Cerithium tectum* d'Orb.; Wollemand: 289, pl. 9, figs 8 & 9.

1906 *Bathraspira tecta* (d'Orbigny) Cossmann: 53, pl. 6, figs. 25-27.

1908 *Cerithium (Bathraspira) tectum* (d'Orbigny) Wollemand: 192.

1948 *Mesalia (Bathraspira) tecta* (d'Orbigny) Delpey: 18, pl. 4, figs 3-4.

1961 *Mesalia (Bathraspira) tecta* (d'Orbigny); Casey: 530 and 607.

MATERIAL AND OCCURRENCE. BM(NH) GG 6227, C. W. Wright collection from Lower Albian, Tardefurcata Zone, Regularis sub-zone, Arnold's Pit, Billington Crossing, Leighton Buzzard, Beds. BM(NH) GG 20790, Albian, Gault, Folkestone, Kent.

DISCUSSION. *Bathraspira tecta* has been described in several of the references given above and it is recorded from the Lower Albian of France, Germany, Switzerland and Madagascar. The only previous British records, apart from Casey's (1961) inclusion of the name in a Lower Cretaceous faunal list (where he records it from the main Mammilatum Bed at Folkestone), are those of Price (1874 and 1879). These references were the basis for the inclusion of *tecta* by Jukes-Browne in his list of Cretaceous molluscs (1900 : 461) where he listed two specimens from the Lower Gault and three from the Upper Gault of Folkestone. Originally, Price (1874) had thought this fossil was found only in Bed 7, but later (1879), he recorded it from his Beds 2, 6 and 7 in the Lower Gault and Bed 9 in the Upper Gault. However, if the BM(NH) specimen GG 6227 is correctly identified, it would provide a slightly older record for Britain than any of these.

Jukes-Browne also listed two specimens of *Cerithium ervynum* d'Orbigny, 1843 from the Lower Gault, but considering the higher horizon from which this species has generally been described, these may also have been *B. tecta*. Forbes (1845 : 351) mentions *tecta* as a variety of *B. neocomiensis* (d'Orb.) 1842, yet his interpretation should probably be disregarded for the specimen he figured (pl. 4, fig. 8) as *neocomiensis* and now in the Geological Survey Museum No. 2272, is thought to be a specimen of *Anchura carinella* (d'Orbigny). Such a conclusion verifies the doubts expressed by Pictet and Campiche (1862 : 298) as to his identification.

D'Orbigny readily distinguished *B. tecta* from all other species by means of its characteristic pagodiform shape, which is the result of the contiguity of the concave adapical part of the whorl and the sharp, posterior carina. However, it must be remembered, that d'Orbigny was referring to the interpretation of the genus *Cerithium* current at that time, a group which virtually included all taxa now placed in the superfamily Cerithiacea. The specific features that d'Orbigny mentioned, including opisthocline growth lines, fine spiral ornament and a second, less prominent carina, are apparent in the majority of the figures published to illustrate the species. Wollemaann (1906 : 289) also mentions the gradual disappearance with age of the fine spiral cords on the adapical parts of the whorl. D'Orbigny figures a third prominent cord below the bicarinate keel of the body whorl.

GG 6227 (Pl. 3, fig. 1) fits these descriptions exactly; its fine spiral cords appear to alternate in strength and are evenly spaced, while there is a strong indication of a third prominent cord on the base of the body whorl. Unfortunately, the aperture is not visible, although it is obvious (Text-fig. 1) that a short anterior canal is present.

Another probable specimen of *B. tecta*, GG 20790, has two interesting features. Firstly, its posterior carina has a slight tendency to become accentuated adapically and this is reminiscent of *B. clevelyi* and *B. shanklinensis* (see p. 127). Secondly, the thickening of the two median spiral cords may also reflect a connection with *B. clevelyi*, which has a single median carina.

Pictet & Campiche (1862) compared *B. tecta* with *Cerithium gurgitus* Pictet & Roux (1849 : 280), yet, although all their specimens were internal moulds, they considered that the species were easily separated on account of their differing spiral angles (quoted as 37° or more for *tecta* and up to 27° for *C. gurgitus*), while the latter was also considered to be more elongate.

In addition to their different stratigraphical occurrence, *B. tecta* and *B. neocomiensis* (d'Orbigny) 1843, can be separated by their slightly different spiral angles, although a comparison of their prominent carinae provides the easiest method of distinguishing them. *B. tecta* normally has two strong carinae, while *B. neocomiensis* has three, the first close to the suture, a strong central one and a third, which is far stronger than the third cord seen on the body whorl of *B. tecta*.

Similarly, although it would seem that *B. tecta* occurs at a lower horizon than *B. fouadi* (Upper Albian), the two species can also be separated by ornamental differ-

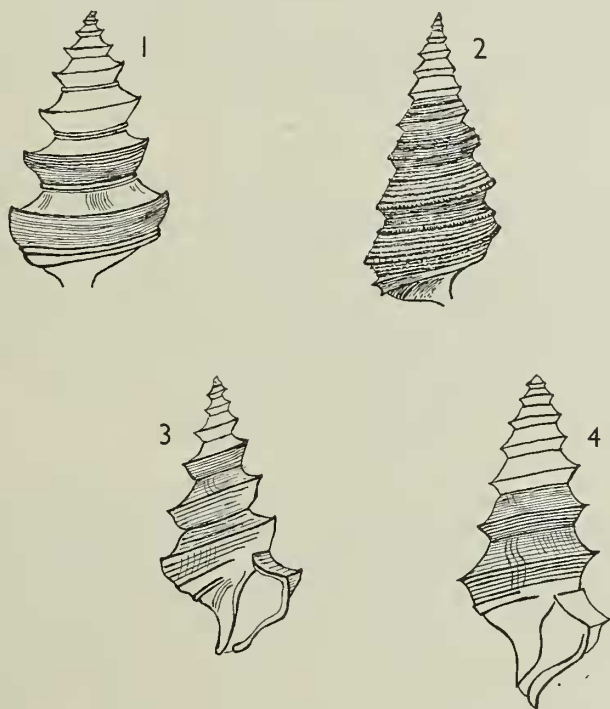


FIG. 1. 1, *Bathraspira clevelyi* sp. nov., Albian, Locality uncertain (see text). BM(NH). GG 5607. $\times 2.5$. 2, *Bathraspira fouadi* sp. nov., Upper Albian, Folkestone, Kent. BM(NH). G 73795. $\times 5$. 3 & 4, *Bathraspira tecta* (d'Orbigny); Fig. 3, Sketch from d'Orbigny's original figure (pl. 238, fig. 4); note suggestion of a third carina; Fig. 4, (after Wollemaann, 1903). $\times 2$.

ences. The former, normally has two carinae and a concave adapical whorl, while in *fouadi* the adapical part of the whorl is straight and relatively elongate and there are three definite carinae (see p. 128).

Peron (1900 : 195), in his comments on the extremely ill-founded Neocomian species *B. beaudouini* (d'Orbigny) 1844, considered that it had a great resemblance to *B. tecta* and could only be distinguished from it by the absence of the pronounced longitudinal striae present in the latter. However, he omitted to make the more justifiable comparison of *B. beaudouini* with *B. neocomiensis*.

Wollemann (1906 : 290) also regarded his Lower Albian species *Cerithium schrammeri* from the Tardefurcataschichten of Algermissen, Germany as being similar to *B. tecta*, but stated that it lacked the constriction below the principal keel. After comparison with his figure, it is difficult to interpret this comment, as the most significant difference would seem to be in the presence of two strong spiral cords on the adapical slope.

Pčhelincev (1927 : 996, 997) has described and badly figured two species, *B. ornata* and *B. multistriata* from the Lower Albian of the Volga Region. Either, or both, of these could be synonymous with *B. tecta* but are said to differ in their sculpture and smaller spiral angles. As justification, Pčhelincev gave the angles as between 35°–40° and he has presumably, taken the figure of 47° given by d'Orbigny rather than the 37° quoted by Pictet and Campiche.

***Bathraspira shanklinensis* sp. nov.**

(Pl. 3, figs 3–6)

DIAGNOSIS. Small pagodiform shell with three strong spiral carinae, the upper edge of the most adapical carina being accentuated and upturned.

MATERIAL. Holotype BM(NH) GG 5602, Ferruginous Sands, Lower Greensand, Upper Aptian, Shanklin, Isle of Wight. Collected C. W. Wright.

PARATYPE. BM(NH) G 20956, Lower Greensand, ?Lower Aptian, Redcliff, Sandown, Isle of Wight.

DESCRIPTION. This small shell has a short, strongly pagodiform spire with a whorl outline that is concave adapically and convex abapically. The suture is linear and moderately deep. The apical whorls are missing in the holotype, but later whorls are ornamented by two spiral carinae of which the posterior is the most prominent. A third carina can be seen on the body whorl and is presumably obscured earlier. The strong posterior carina is practically central on the whorl and the pagodiform appearance of the shell is accentuated by its upper edge becoming upturned to form a sharp ridge. In both specimens, the adapical surface of the whorl is poorly preserved but appears to be virtually smooth, whereas the whole surface below the posterior carina is crossed by equally spaced and prominent, fine spiral threads. The convex base is also ornamented by fine spirals. On the body whorl, growth lines become prominent at unequal intervals. The aperture is not completely preserved, but is roughly pentagonal and a short curved anterior canal is present.

DIMENSIONS. Holotype BM (NH) GG 5602.

Height (4 whorls)	.	.	.	.	.	.	11.7 mm
Spiral angle	.	.	.	.	.	.	20°
Whorl height	.	.	.	.	.	.	7.0 mm
Whorl diameter	.	.	.	.	.	.	7.5 mm

DISCUSSION. The characteristic pagodiform shape and shell ornament establish this fossil as belonging to *Bathraspira*, while the three very strong carinae immediately distinguish it from any other species of that genus. The distinctive upturned edge of the most posterior carina is also seen in *B. clevelyi* and a specimen of *B. tecta* shows the same feature. This character considered in conjunction with the virtual exclusion of all ornament on the adapical ramp in each of these species, leads to the conjecture that there is some close affinity between them, or that this development may have some ecological significance. *B. excavata* Nagao (1934 : 258, pl. 34, figs 5 & 8) from the Cretaceous, Aptian, Hiraiga Sandstone of Japan, possesses a similar, sharp, upturned ridge on the posterior carina. However, the general whorl shape of this species is more convex and none of the spiral cords are as strong as those of *B. shanklinensis*.

The dramatically upturned carina of *B. shanklinensis* enables it to be distinguished easily from the earlier *B. neocomiensis*. This carina is undoubtedly the strongest of the three present; whereas, in *neocomiensis*, it is the central one that is most prominent.

A. N. Ivanova (1959 : 362, pl. 15, figs 11 & 12) has described an Aptian gastropod from Saratov, U.S.S.R. as *Bathraspira subornata*. Although this is poorly figured, it is possible to discern a median carina, an abapical spiral cord and the concave form of the adapical half of the whorl. The last whorl is said to have a third carina on the base of the shell. In the figure, the fine axial riblets ornamenting the whorls, appear to be tubercles, or at least much stronger than described; and these alone would distinguish that species from *B. shanklinensis*.

Bathraspira clevelyi sp. nov.

(Pl. 3, fig. 10)

DIAGNOSIS. Pagodiform shell with prominent median, slightly upturned, carina; smooth concave adapical whorl surface, while convex lower whorl ornamented by numerous spiral cords and a smooth astragal towards the base.

MATERIAL AND LOCALITY. BM(NH) GG 5607a & b. Lower Albian, Tardefurcata Zone, a split Regularis-nodule from either Leighton Buzzard, Beds., or Bed 5, Ford Place, Wrotham, Kent.

DESCRIPTION. A small pagodiform shell with whorls that are approximately concave posteriorly and convex anteriorly of a median carina, and which are separated by a finely-channelled suture. The concave adapical part of the whorl is accentuated by a thin upturned carina and, apart from the growth lines, is quite smooth. The outer side of the carina and the abapical part of the whorl are ornamented by a large number of spiral cords (29 are visible on the incomplete body

whorl). The cords on the carina are close together, but below this they are more evenly spaced and of equal strength until reaching a strong cord towards the base that forms an astragal. The aperture is not preserved in this unique specimen. Growth lines are opisthocyrt and suggest a shallow apertural sinus at the ramp.

DIMENSIONS. Holotype. BM(NH) GG 5607.

Height (6 whorls)	. . . . .	approx.	18.0 mm
Spiral angle	. . . . .		23°
Penultimate whorl height	. . . . .		4.0 mm
Penultimate whorl diameter	. . . . .		9.3 mm

DISCUSSION. The distinctive strong, rounded cord forming an astragal towards the anterior, and the regularity of its numerous spiral cords serve to distinguish this from other described species of the genus.

Bathraspira fouadi sp. nov.

(Pl. 3, figs 7, 12 & 13)

DIAGNOSIS. Pagodiform shell frequently with three carinae of which the most posterior is the strongest; adapical slope of variable form ranging from straight and elongate to concave and ornamented by numerous, or few spiral cords.

HOLOTYPE. BM(NH) G 73795, J. S. Gardner collection.

PARATYPE MATERIAL. BM(NH) G 71562, GG 20792-20797; Sedgwick Museum B 32524.

LOCALITY AND HORIZON. All from Folkestone, Kent and probably the Upper Albian.

DESCRIPTION. Small, pagodiform shell with a channelled suture. At least three carinae occur, of which the most posterior is the strongest. Although this prominent carina is in the centre of the whorl, the relatively flat, or concave, adapical slope above it appears to occupy the upper two-thirds of the whorl. In the holotype (G 73795) and paratypes (GG 20794-20795), this is accentuated by the numerous spiral cords ornamenting this slope (see Text-fig. 1).

Ornament consists of spiral cords that are crossed by thin collabral threads. On the initial whorls, this produces a reticulate pattern, but on later whorls (particularly in the elongate varieties) the cords have a beaded appearance. The spaces between the collabral threads are extremely variable and they are frequently three times the width of a thread. The spiral cords vary in number, strength, pattern and position.

Primary and secondary cords alternate on the adapical slope, with the second of the primary cords being fairly prominent (see holotype G 73795. pl 3, fig. 12). Abapically to the dominant carina, the whorl slopes away to a moderate basal carina and this surface is ornamented by a varying number of spiral cords. Occasionally, e.g. GG 20792, one of these cords is strong enough to produce a third carina. In the holotype a small shelf is produced just above the basal keel.

Normally, only a single spiral cord occurs at the prominent carina, but in the holotype there are three, and in G 71562 and SM B 32524 there are also several cords.

A number of fine spirals occur on the convex base and these are crossed by the

growth lines. The growth lines show a wide shallow sinus, that has its apex at the principal carination. The aperture is not completely preserved in any specimen, but would appear to be sub-orbicular in shape and to possess a short anterior canal.

DIMENSIONS.

	SM B 32524	Holotype BM(NH) G 73795	BM(NH) GG 20793
Height	approx. 19.0 mm	21.0 mm	14.2 mm
Height of last whorl	approx. 10.0 mm	8.0 mm	5.9 mm
Maximum diameter	9.7 mm	9.6 mm	7.2 mm
Outside spiral angle	31°	27°	29°

DISCUSSION. The specimens included in this species show considerable variation in both ornament and the form of the adapical slope. Some of the most variable forms are figured on pl. 3 and have fewer spiral cords, a more concave adapical slope and several spiral cords on the prominent carina. In G 71562 the carina is much wider than usual, while in S.M. B 32524 it is much sharper. It is possible that G 73797 (see pl. 3, fig. 13)—a specimen in which the adapical ornament is strongly developed and also shows some variation in the position of the abapical keels—might be recognized as another variety, or even with more material a separate species. The ornament and generally straight, elongate form of the adapical slope provide sufficient criteria to distinguish *B. fouadi* from other known species, e.g. *B. tecta*.

B. neocomiensis (d'Orbigny 1843, pl. 232, figs 8–10) also possesses three carinae but the central one is the most prominent and enables the two species to be separated. It may be worth noting that the stronger spiral cord on the adapical slope of *B. fouadi* occurs in a similar position to the posterior carina of *B. neocomiensis*. The smaller spiral angle of *B. fouadi* (31°) assists in separating it from the Lower Albian *B. tecta* (37°). The latter also has an ornamented adapical slope, but this is concave and its spiral cords are not beaded. The variable forms of *fouadi* are in many respects, intermediate between *B. tecta* and the holotype *B. fouadi*.

The strong development of spiral cords in *B. brightoni*, which produce an irregular whorl outline, readily distinguish it from *B. fouadi*. The position of the adapical carina in the former also coincides with that of the stronger spiral cord in *fouadi*. The convex appearance of *B. ervynym* (d'Orbigny, 1843 : 367, pl. 230, figs 1–3) enables it to be distinguished from *B. fouadi*, although the unequally distributed spiral cords, small spiral angle (25°) and the more abapical position of its prominent carina are other useful distinguishing features.

Bathraspira brightoni sp. nov.

(Pl. 3, figs 9 & 14)

DIAGNOSIS. Pagodiform shell, with 2 carinae; whorls ornamented by spiral cords that are strongly developed on the adapical slope, one of which forms an astragal or third carina, giving the whorl an undulating outline.

HOLOTYPE. BM(NH) G 73796, J. S. Gardner Collection, Albian, Gault, Folkestone, Kent.

OTHER MATERIAL. BM(NH) 34843, Albian, Upper Greensand, Blackdown, Devon; BM(NH) GG 20791, Gault, St. Florentin, Yonne, France, may belong to this species.

DESCRIPTION. Medium-sized shell with a channelled suture and its pagodiform shape is emphasized by the strong development of several spiral cords. On the initial whorls two of these produce carinae, with the abapical one the more dominant. Later, a third carina develops abapically to these. The crest of the principal carina is rounded, carrying three to four strong spiral threads. Two similar cords occur on the posterior carina.

The whorl outline is convex between the suture and the adapical carina and ornamented by a weak and a strong spiral cord. Below this, and before the main carina, the whorl is concave. Eleven variable spiral cords of which the fifth and ninth are particularly strong, ornament this surface. Anterior to the rounded main carina, the whorl again becomes concave and is covered by four equally spaced cords. Finally, the surface abapical to this, is covered by a further six spiral cords, with an indefinite number of threads on the convex base and within a slight basal carina.

The spiral cords are crossed by thin collabral threads, that are regular and separated by interspaces equal to twice their width. The growth lines show a shallow U-shaped sinus with its apex lying on the dominant carina. The aperture is not completely preserved, but in GG 20791 part of a short curved anterior canal is present.

DIMENSIONS. Holotype BM(NH) G 73796.

Height (10 whorls)	. . . . .	16.3 mm
Spiral angle	. . . . .	23°
Penultimate whorl height (between sutures)	. . . . .	4.2 mm
Penultimate whorl diameter	. . . . .	7.0 mm

DISCUSSION. Despite its poor preservation, the Blackdown BM(NH) 34843 specimen appears to belong to this species. It has a roughly similar whorl shape with virtually identical ornament, but the adapical carina is almost as prominent as the central one. In the slightly flattened French specimen GG 20791, the prominence of the main carina, and the concavity in the whorl outline, are not developed to the same degree as those of the type, but again, ornament is identical, with its strong spiral cords in exactly similar positions.

The characteristic whorl outline consisting of prominent carinae and their intervening sulci separate this species from other Cretaceous members of the genus.

The development of several cords on the carinae can also be observed in specimens of *B. fouadi*. The identical positions of the prominent adapical cord of *B. fouadi* and the adapical astragal of *B. brightoni* are also significant indications of a close relationship.

The record of *Cerithium neocomiensis* by Price (1879 : 67) from the Blackdown Greensand could have been another example of this species.

Genus **METACERITHIUM** Cossmann, 1906

TYPE SPECIES. By original designation, Cossmann (1906 : 54), *M. trimonile* (Michelin).

DIAGNOSIS. (After Cossmann, 1906 and Wenz, 1939).

Medium-sized to small, turriculate, conical shell. Sharp spire at summit. Numerous, narrow, flat-sided whorls, that broaden at their base. Ornament generally consists of three granulose spiral cords. Growth lines parasigmoidal. Grooved linear suture. Last whorl not particularly high and angular at basal periphery. Sloping base weakly convex, ornamented by fine spiral cords and strongly curved collabral threads. Aperture sub-rectangular, weakly channelled posteriorly and with a short rudimentary anterior canal. Outer lip strongly sinuous adapically and projecting anteriorly. Columella slightly curved, straight initially but twisted at its anterior end, with an oblique columellar fold. Parietal lip quite thick but not extensive.

REMARKS. Cossmann (1906 : 21) considered that the rudimentary canal of *Metacerithium* had derived from the 'beak' of *Paracerithium*, but he also realized that the fossil evidence indicated that such a feature had evolved independently in different groups at different times. The poor preservation of later Cretaceous material prevented him elaborating on the development from *Metacerithium*, but in this connection, he referred to the occurrence of undoubted members of the Cerithiidae, i.e. with a well-formed prominent anterior canal, in the Turonian.

Cossmann distinguished *Metacerithium* from *Paracerithium* by the protrusion of its rudimentary canal from below the general line of the aperture and shell and referred to it as a 'rudimentary neck'. In association with this, the whorl becomes more convex and, in effect, the aperture widens with the lower lip extending adaxially.

Pchelincev (1953 : 190) stated that the basic features of ornament in *Metacerithium* have remained stable and that consequently it is extremely difficult to separate specimens from quite different stratigraphical horizons using this character. The British Cretaceous examples of the genus, e.g. *M. trimonile*, show that there is considerable range of ornament within a species, but until more details of its range and development have been obtained, it is not feasible to dismiss Pchelincev's assertion. However, it is probable that an investigation of the development of the ornament will be significant in understanding the evolution within the genus.

Metacerithium turriculatum (Forbes)

(Pl. 5, figs 8-11)

1845 *Cerithium turriculatum* Forbes: 352, pl. 4, figs 7a & 7b.

1862 *Cerithium turriculatum* Forbes; Pictet & Campiche: 301.

1961 '*Cerithium*' *turriculatum* Forbes; Casey: 608.

SYNTYPES. Geol. Survey Museum, Geol. Soc. Collection, 2253 and 2255, stated to come from the Lower Greensand, Crackers Bed, Atherfield, Isle of Wight. Although each specimen has been labelled according to the figure with which it is alleged to

correspond, there is no exact resemblance between any of the specimens and Forbes' figures. This may be due to the specimens suffering some slight damage, but is more probably a result of the original figures being rather stylized.

OTHER MATERIAL. BM(NH) G 20907, G 70131, G 74602, GG 5640 and GG 20812-20814 all from the Lower Greensand, Atherfield, Isle of Wight. BM(NH) GG 6087 an external mould from the Atherfield Clay, Littleton, nr. Guildford, Surrey; G 20878, Atherfield Clay, Sevenoaks Tunnel, Kent; and Geol. Survey Museum 93681, (Atherfield Clay), East Shalford, Surrey.

HORIZON. Lower Greensand, Lower Aptian, Deshayesites forbesi Zone.

DESCRIPTION. Small turriculate shell, with a tuberculate carina situated one third of the whorl height away from the adapical suture and a virtually smooth beaded (or growth-line notched) spiral cord at the adapical suture. This cord gradually becomes wider giving rise to a slight sutural shelf on later whorls and is emphasized by the slight groove that occurs beneath it. The suture is grooved and moderately deep. On the body whorl a secondary carina occurs below the principal one.

The tubercles are particularly strong on the early whorls and almost equivalent to ribs. Subsequently, they become more noded and concentrated at the carina, although still tapering adapically and abapically (later, this effect is only apparent on the adapical slope). The tubercles gradually increase in number (about 8-10 per whorl at first, to 12-16 later) and have a tendency to become slightly opisthoclinal on later whorls. In common with other species of *Metacerithium* the tubercles virtually disappear on the body whorl.

The adapical slope is feebly concave, while the abapical one is convex. Their surfaces are almost smooth, but variable development of fine spiral threads and the growth lines can produce a cancellate ornament in some specimens, particularly on the adapical surface. In others, the growth lines are at first opisthocyrte, then become opisthoclinal below the tuberculate carina and finally swing back to the short, thick columella, i.e. they may be described as parasigmoidal.

The almost smooth convex base is bordered by the slight secondary carina. The aperture appears to be of average size and has a short anterior canal.

DIMENSIONS.

	BM(NH) G 74602	<i>M. rikuchuense</i> Nagao (see under discussion)
Height (9 whorls)	11.0 mm	17.0 mm approx.
Spiral angle	15°	15°
Whorl diameter	5.0 mm	6.3 mm
Whorl height	4.2 mm	

DISCUSSION. This species is readily distinguished from other species of *Metacerithium* by the prominent, beaded spiral cord close to the adapical suture. The whorl shape and strong tuberculate carina also provide other diagnostic characters. A similar ornament pattern occurs on the early whorls of *M. trimonile*. In his figures of *M. turriculatum* Forbes appears to have accentuated the tubercles, for they

are not quite so strong in the actual specimens and are typically reduced on the last whorls.

Apart from brief records in lists, e.g. Blake (1902 : 15) and Casey (1961 : 608) the species has not been mentioned in the literature since Forbes' original description. Pictet & Campiche (1862 : 301) did comment on the association of a species '*C. tuberculatum* Forbes' by d'Orbigny (1850 : 116) with *C. aptiense* d'Orbigny. They concluded that it was a misprint for *C. turriculatum* Forbes and decided that the dominant carina and larger tubercles of *C. aptiense* were sufficient to distinguish the two.

The ornament shown on the earlier whorls in figures of *C. disparile* Buvignier (1852 : 42, pl. 28, figs 5a & b) is partly comparable to that of *C. turriculatum*. However, any resemblance is limited to the beaded adapical cord and growth line shape, for the carina is not tuberculate and occurs mid-whorl, nor is there any indication of a secondary carina towards the base.

M. turriculatum (Forbes) is obviously closely related to *M. rikuchuese* Nagao (1934 : 256, pl. 35, figs 4-7) from the Aptian, Hiraiga Sandstone of Japan. Nagao's figures are not particularly clear, but the 'supra-sutural band', ornamented by rounded granules, that he describes is identical to the beaded spiral cord occurring in *M. turriculatum*. The whorl shape of the two species appears to differ; that of the Japanese species being three times broader than high, with flatter whorls and a less inflated base. Nagao also describes the opisthocline growth lines as being rib-like and divided into two by a narrow, indistinct, spiral depression.

Metacerithium trimonile (Michelin), 1838

(Pl. 4, figs 2, 3, 7, 8 & 10)

1838 *Cerithium trimonile* Michelin: 100, pl. 12, fig. 5.

1844 *Cerithium trimonile* Michelin; d'Orbigny: 369, pl. 230, figs 7-9.

1845 *Cerithium trimonile* Michelin; Reuss: 42, pl. 60, fig. 2.

1862 *Cerithium trimonile* Michelin; Pictet & Campiche: 303.

1868 *Cerithium trimonile* Michelin; Stoliczka: 199, pl. 15, fig. 9; pl. 19, figs 2 & 3.

1906 *Metacerithium trimonile* (Michelin) Cossmann: 54, pl. 6, figs 29-31.

MATERIAL. BM(NH) J. S. Gardner Collection, GG 6470-6472, GG 20799-20811 and G 73794.

LOCALITY AND HORIZON. Middle to Upper Albian, Gault, Folkestone, Kent. *Metacerithium trimonile* has been recorded from the Albian of both Germany and Switzerland and is common in the Gault of France.

DESCRIPTION. Medium-sized, slightly coeloconoid shell that Stoliczka (1868) has described as awl-shaped. Whorls increase very gradually in height and width, but are three to four times broader than high. Grooved sutures occur 1-2 mm below a basal carina and above the slight bevel at the top of the succeeding whorl; consequently the groove is asymmetric. Each of the later whorls are ornamented by three rows of small rounded tubercles, which are smaller but more numerous on the posterior row, rather weaker on the central row and strongest on the anterior row. Some variation in this pattern is apparent within the material available. Occasion-

ally, the abapical row on the body whorl is merely a carina with breaks caused by the crossing of the growth threads. The number of tubercles per row decreases as their strength increases, e.g. posterior row 15–18 per whorl; centre row 13–15; anterior row 12 per whorl. The entire whorl surface is also covered by faint spiral threads and opisthocline growth lines. The abapical row of tubercles occurs on, or at the basal carina and the smooth convex base is below this. The growth lines (see pl. 4, fig. 3) above this 'carina' are opisthocline, but beneath, they first continue forward to produce a rounded projection on the base and then swing back towards the columella. The aperture is quadrangular and prolonged anteriorly into a short curved canal.

The early whorls have been completely preserved in several specimens and it has been possible to observe the sculptural ontogeny of the shell. In some respects this differs from the description by Stoliczka (1868 : 199). On the second whorl, there are about ten opisthocline axial ribs and by the third whorl these are well-developed. A smooth sub-sutural band becomes apparent above the ribs on the fourth and fifth whorls. The axial ribs gradually thicken and now only number eight per whorl. Eventually this thickening leads to the ribs becoming nodose at their anterior end and on the tenth whorl this produces a carina. At the same time, there is a tendency for them to straighten, i.e. become more orthocline.

Meanwhile on the subsutural band there are indications of nodes, these gradually become tuberculate and the whole band projects a little. By the tenth whorl this results in an established tuberculate carina. On the eleventh whorl, the axial ribs begin to separate into two, giving rise to the central and anterior rows of tubercles, which are completely developed by the fourteenth whorl. Each rib also broadens and loses its definite axial keel.

DISCUSSION. There are few records of the occurrence of this species in Britain. Jukes-Browne (1900 : 50 & 461) listed 5 specimens from the Lower and Upper Gault of Folkestone and Casey (1961 : 601) has recorded it from the Mammilatum Zone. *M. trimonile* is easily distinguished from *M. ornatissimum* (Deshayes) by the presence of three, instead of two tubercular spirals.

After comparison with topotype material Stoliczka (1868 : 199) described this species from the Arrialoor group (Maastrichtian) of Southern India. Although the Indian forms are undoubtedly very similar, Pchelincev (1953 : 190) considered that they were narrower and showed more strongly differentiated ornament. On these grounds, and because they also occurred at a much higher horizon, he renamed Stoliczka's material as a new species, *M. stoliczkai* Pchelincev, 1953. Collignon (1949 : 37) indicated this possibility when comparing some very small cerithid specimens from the Albian of Madagascar, with *M. trimonile*.

Pchelincev, also described another species, *Metacerithium amudasiensis* (1953 : 188, pl. 33, figs 5–12) from the Senonian of Central Asia, that is very similar to *trimonile*. He distinguished this new species by its slightly wider and more rounded sutural area and the fact that the whorl outline is a little more convex. The Upper Cretaceous species, *Metacerithium abictiforme* (Wanner, 1902) described from the Western Desert of Egypt and given a Danian age (Abbass 1963 : 51) is closely related to these species.

Two Albian species from the Perte-du-Rhone also have ornament which resembles

that of *M. trimonile*. *Cerithium derignyanum* Pictet & Roux (1849 : 277, pl. 27, fig. 4) has three rows of tubercles with those of the anterior row being the largest, while *Cerithium rhodani* Pictet & Roux (1849 : 279, pl. 27, fig. 6) although having three prominent cords, has tubercles on only two of them.

The considerable variation in the basic ornamental features of the specimens described here as *M. trimonile* is particularly noticeable. Such variation occurs in the relative strength of the tubercular rows; slight positional changes of these rows; alteration in the shape of the tubercles; variation in the strength of the secondary spirals and the collabral threads and in the development of either cancellate ornament, or axial ribs. At present, the extent and significance of these differences is not understood and consequently all such forms are regarded as *M. trimonile*.

Several specimens found in the Gault at Folkestone have features between those of *M. trimonile* and *M. ornatissimum*. BM(NH) G 73793 (pl. 4, figs 1 & 6) is ornamented by two strong tuberculate carinae, with the anterior one being slightly more prominent. The tubercles are somewhat circular on early whorls but become slightly elongate on the body whorl. The concave whorl surface between the carinae is ornamented by opisthocline growth lines that accentuate the tubercles of the anterior row. The lack of a third row of tubercles separates this specimen from typical *trimonile*, while the deep furrow at the suture distinguishes it from *ornatissimum*.

GSM 1698 and SMB 32518 are two examples (pl. 5, figs 4 & 11) that have a closer similarity to *ornatissimum*. Both specimens have a row of tubercles occurring on fairly wide, rounded convex cords close to the adapical and abapical sutures. In the Survey specimen, the tubercles of the posterior row are elongated axially, while those of the anterior row are opisthocline. In SMB 32518, the tubercles are very rounded and strong. Spiral cords cover both whorl surfaces and in GSM 1698 contribute to the cancellate ornament occurring on the narrow interspace between the two primary cords.

GSM 93725 (pl. 5, fig. 6) also has two rows of tubercles (a row situated close to each suture) but in this specimen the tubercles are not prominent and the outline of later whorls is somewhat convex. There is an indication of a third, central, line of tubercles on some of its whorls, which may mean that this specimen is an eroded *M. trimonile*, although apart from the tubercles, the whorl surface appears to be quite smooth.

Metacerithium ornatissimum (Deshayes), 1842

(Pl. 4, figs 5 & 12)

1842 *Cerithium ornatissimum* Deshayes, in Leymerie: 14, pl. 17, fig. 10.

1843 *Cerithium ornatissimum* Deshayes, d'Orbigny: 370, pl. 230, figs 10 & 11.

1852 *Cerithium mosense* Buvignier: 42, pl. 29, figs 10-13.

1862 *Cerithium ornatissimum* Deshayes, Pictet & Campiche: 290, pl. 71, fig. 10.

1862 *Cerithium mosense* Buvignier, Pictet & Campiche: pl. 71, fig. 11.

1864 *Cerithium ornatissimum* var. Seeley: 89.

1900 *Cerithium ornatissimum* Deshayes, Wollemann: 169, pl. 8, fig. 6.

1906 *Metacerithium ornatissimum* (Deshayes) Cossmann: 55, pl. 6, fig. 28.

MATERIAL AND LOCALITY. A number of crushed internal moulds from the Grey Chalk of Dover, Kent, BM(NH) 48152 and G 4315; BM(NH) G 28908, G 74483 from Merstham, Surrey: GG 5601, Varians Zone, Aston Clinton, Bucks.; G 23506, Varians Zone, Chilton, Berks.; 34540 & 8655, Chalk Marl, Hamsey, nr. Lewes, Sussex.

OTHER OCCURRENCES. Kennedy (1969 : 534) records 4 specimens from Band 2 of the Middle Cenomanian, at Bluebell Hill, nr. Burham, Kent. *M. ornatissimum* is described as common in the Gault of France (Departments of the Aube and Meuse); the type coming from Racines, N.W. of Ervy. Wollemaun (1900) lists the species from Hildesheim, in N.W. Germany and Pictet (1862) mentions it in the Gault of Switzerland.

DESCRIPTION. Medium-sized, conical shell that is slightly coeloconoid. Its whorl outline is flat to feebly concave and the whorls are three to four times wider than high. The suture is partly obscured by the ornament, but appears to be impressed, or slightly grooved.

The early whorls are not sufficiently well-preserved to determine their ornament. On later whorls a row of tubercles forms an astragal at both the adapical and abapical sutures. Frequently the posterior (adapical) row obscures the other. The tubercles are more prominent, regular and compact on the adapical row and slightly axially extended across the width of the ridge produced. A shallow groove may demarcate the boundary of this adapical row. On the abapical astragal the tubercles are fewer in number and in some specimens, extend adaxially, crossing the interspace between the two tubercular rows and almost reaching the adapical astragal. These rib-like extensions follow the opisthocline growth lines.

The entire whorl surface, including the tuberculate astragals, is ornamented by spiral cords and these vary considerably in thickness and number. These cords together with the opisthocline growth lines produce a cancellate ornament.

On adult specimens the abapical row of tubercles tends to disappear, becoming reduced to a sharp carina that is notched by the numerous oblique growth lines that cross it (see d'Orbigny; Seeley; Wollemaun). The flat, slightly convex base below this carina is relatively smooth and only ornamented by the sinuous growth lines. The aperture is not completely preserved, but earlier accounts have described it as angular, or quadrangular, with a straight canal that is curved at its end.

DISCUSSION. All of these British specimens have been found in the Cenomanian, *Schloenbachia varians* Zone of S.E. England. Jukes-Brown (1900 : 192, 203 & 561) has recorded specimens from the *variens* and *subglobosus* Zones of Cambridgeshire, Bedfordshire and Hertfordshire. Only Seeley (1864 : 89) has described this species in Britain and he considered that his examples were a distinct variety.

Wollemaun (1900 : 169) concluded that it was impossible to separate *C. ornatissimum* Deshayes from *C. mosense* Buvignier. In this paper, *C. mosense* is regarded as a synonym of *M. ornatissimum*, for the minor differences mentioned by Buvignier (1852) and Pictet & Campiche (1862) are insufficient to exclude *C. mosense* from the range of variation seen within specimens of *M. ornatissimum*. In fact, the two figures shown by Pictet and Campiche are very similar. Their comment on the differing stratigraphical occurrences of the two forms is ill-founded, since only

moulds were available from the lower horizon for comparison with *ornatissimum*. However, their dubious observation of 'traces de dents variqueuses' in *ornatissimum* (p. 294) probably convinced them that two species were involved. In shells that are coeloconoid (i.e. the spiral angle changes with growth) it is not possible to distinguish fossil species on slight changes in spiral angle, as Pictet & Campiche attempted.

The growth lines and ornament show that *M. ornatissimum* is comparable to the type species *M. trimonile* and with *M. turriculatum*. It differs from *M. trimonile* in having two rows of tubercles rather than three and in that these rows form strongly rounded astragals. Such a difference is essentially one of ornament style and is best understood from the illustrations (see pls 4 & 5).

Stolizcka (1868 : 200) considered his Cenomanian species, *Cerithium fertile* (pl. 15, figs 11 & 12), from Southern India, as being very close to *M. ornatissimum*. The higher whorls of *C. fertile* enabled him to distinguish the two species while its additional ornament of two rows of smaller tubercles in the centre of the whorl supported this view.

Cerithium sabaudianum Pictet & Roux (1849 : 279, pl. 27, fig. 5) from the Gault of Saxonet, Switzerland, also bears some resemblance to *M. ornatissimum*, in having a tubercular astragal at each suture and would only appear to differ in that the spiral angle is much smaller.

Another closely related species *Cerithium delpeyae* Collignon (1949 : 36, pl. V, fig. 9) from the Albian of Madagascar can be distinguished from *ornatissimum* by the central position of its second abapical row of tubercles.

The two species described by Pčhelincev (1927), *Metacerithium dentatum* (p. 165, pl. 4, fig. 29) and *M. renngarteni* (p. 282, pl. 9, fig. 3) from the Lower Cretaceous of the Crimea and Caucasus are so poorly figured that it is impossible to make any comparison with them. The shape of the latter suggests that the species has been incorrectly identified as *Metacerithium*.

Metacerithium? sp. nov.

(Pl. 4, fig. 9)

MATERIAL. Sedgwick Museum, B 32530 from the Albian, Gault of Folkestone, Kent.

DESCRIPTION. Small, almost smooth, broadly conical shell. The whorl outline is slightly convex with a low anterior carina. Linear, subcarinal and superficial suture. A single poorly-preserved specimen that only shows part of the ornament of its last three or four whorls. There are ten to twelve fine, equal spiral cords separated by interspaces that are equal to the width of the cords. Fine thread-like opisthocline growth lines that have a shallow sinus, cross these cords producing a cancellate ornament. Only the growth threads occur on the convex base. The aperture is not present.

DISCUSSION. This species is provisionally included in the genus *Metacerithium* on the basis of its general shell shape and the similarity of its base and growth lines to other species of this genus. Its distinguishing convex whorl outline might be due to

the vagaries of preservation but its lack of strong tuberculate spiral ornament does appear to be a more definite feature. *Metacerithium dentatum* Pchelincev 1927 (:165) is also said to be smooth, but as previously mentioned, it is so badly figured that further comparison is not possible.

Genus *CIMOLITHIUM* Cossmann, 1906

1906 *Cimolithium* Cossmann: 57.

1934 *Cimocerithium* Cossmann, Nagao: 254.

TYPE SPECIES. By original designation (Cossmann, 1906: 57), *Cerithium belgicum* Münster (1844, pl. 174, fig. 5) from the Tourtia (Cenomanian), at Tournai, Belgium.

Cossmann defined this genus as consisting of moderately large turriculate shells, with flat to concave whorl sides ornamented by a row of tubercles immediately below the suture and having a quadrangular aperture. He was uncertain as to the existence of an anterior canal, but Wenz (1939: 735) mentioned a weak canal, while Allison (1955: 419) described a moderately long and straight canal in his species *C. eleanorae*. If the latter is correct, there must be some doubt about its inclusion in the Procerithiidae.

Only the type species *C. belgicum* (Münster), 1844, of those listed by Cossmann (1906: 58) in his original description of *Cimolithium* can still be included in this genus with certainty. The relationship of the others is doubtful and requires further investigation. *C. inauguratum* Stoliczka (1867: pl. 15, figs 19, 20) could be a *Campanile*; *C. hispidulum* Stoliczka (1867: pl. 15, figs 16–18) has some resemblance to the Tertiary genus *Brotia*; and after consulting a figure of the holotype of *C. gallicum* d'Orbigny 1843, in Guéranger (1867, pl. 14, fig. 5) it is doubtful whether that species is a *Cimolithium*.

Occasional examples of this genus occur in widely separated areas, e.g. Western Europe, Japan and U.S.A., during the Aptian and Cenomanian. The specimens described below are the first indication of the occurrence of the genus in Britain.

Cimolithium ascheri (Wollemann) 1908

(Pl. 2, figs 6, 7, 9, 10)

1908 *Cerithium ascheri* Wollemann: 180, pl. 13, figs 8 & 9.

HOLOTYPE. Original number 414–415 in the Geologisch-Palaeontologisches Institut der Georg-August Universität, Göttingen; Neocomian, from Bohnenkamp nr. Querum, Sarstedt, North Germany.

MATERIAL AND HORIZON. Speeton Clay, Hauterivian-Barremian. BM(NH) G 67942 (no history recorded); GG 20820, Cementstone Group (Barremian), Cayton Bay, Yorks.; GG 20821, C1 or B beds (Hauterivian-Barremian), Black Cliff, Speeton, Yorks.; GG 5944 (Hauterivian) C8, Speeton, Yorks.; GG 6269 (Valanginian-Berriasian) D1, Speeton, Yorks.; G 55359, (Barremian) B Beds, Speeton, Yorks.

DESCRIPTION. Shell of medium size; initially, spire acutely conical and whorls a

little convex, but later whorls progressively increase in diameter producing a rather coeloconoid shell. The whorl has an angular edge at its base. The early whorls are missing on all available British specimens, but the first preserved whorls (presumably the 4th and 5th after the protoconch) are very slightly convex and bear rounded axial ribs. These ribs are opisthocline, are separated by constricted interspaces and follow the growth lines. On the next visible whorl (in GG 20820) the ribs are lost and only the growth lines and two tuberculate astragals occur, the larger one at the adapical suture and the smaller one abapically. The astragals are formed by a linked series of rounded tubercles.

The whorl outline between the astragals gradually becomes more concave. Faint spiral threads occur on each whorl. Initially, the growth lines are opisthocyrt, but become opisthocline and on the slightly rounded base of the last whorl they can be seen to arch forward. Little of the aperture is preserved in these specimens, but it is thought to have a broad sinus and to be rather quadrangular. It also appears to have a calloused parietal lip and a suggestion of a posterior channel. The extent of the anterior canal is not known.

Most of the specimens from the Speeton Clay have lost their ornament and have flat to slightly convex whorl outlines. In GG 20820, the ornament has been preserved, and this shows a grooved linear suture between the noded abapical and adapical astragals of adjacent whorls.

DISCUSSION. Wollemaann commented that the ornament of his new species was similar to that of *Cerithium sanctaecrucis* Pictet & Campiche, (1864 : 283, pl. 70, fig. 14). Ascher (1906 : 148) mentioned the confusion that has arisen in distinguishing that species and both *C. terebroides* d'Orbigny (1842 : 352) and *C. ricordeanum* Cotteau, (1854 : 43). Cossmann (1906 : 48) included them all in his genus *Terebrella*, which he placed in the sub-family Paracerithinae. This may have been the reason that caused both Allison (1955 : 419; *C. eleanorae*) and Nagao (1934 : 254, *C. miyakoense*) to overlook the similarity of their species to *Cerithium ascheri*. In fact, it is this resemblance of ornament together with its general shell shape, which suggests that *Cerithium ascheri* belongs to the genus *Cimolithium*.

This early species of *Cimolithium* with a carina at the edge of the base, differs from *Gymnocerithium* which possesses a more rounded base and in this respect resembles *Metacerithium*. However, both the BM(NH) material and Wollemaann's holotype (kindly sent on loan for comparison by Dr S. Ritskowski, of Göttingen) show a thickened inner lip, as occurs in *Gymnocerithium*. The quadrangular aperture of *C. ascheri* readily distinguishes it from that genus, while its ornament of noded astragals and the less pronounced anterior canal (in contrast to a curved beak-like shape) serve to separate it from *Metacerithium*. Yet, other features, such as the numerous narrow whorls, the general coeloconoid shape and the small apertural posterior neck, are similar to those found in *Metacerithium*.

The comparable shell shape and ornament of the Aptian *Cerithium sanctaecrucis* Pictet & Campiche (1864 : 283, pl. 70, fig. 14) indicates that this species is another early *Cimolithium*. The relationship and distinctions between it and both *C. terebroides* d'Orbigny and *C. ricordeanum* still need to be verified by examining type

material, but they can all be distinguished from *C. ascheri* in that they only have one noded astragal.

Another slender, turriculate species, *Cimolithium elaneorae* Allison (1955 : 419) from the Middle Albian of Mexico, has two noded astragals but can be recognized by its additional ornament of strong axial ribs. The early whorls of the Japanese Aptian species *Cimolithium miyakoense* Nagao, (1934 : 254), have prominent axial ribs, but later, these are reduced to a series of adapical and abapical nodes. However, in *C. miyakoense* var. *tomasensis* Allison, 1955, the axial ribs are persistent, while the whorl diameter progressively increases to give a somewhat coeloconoid shape as occurs in *C. ascheri*.

The Cenomanian *C. belgicum* from Tournai, differs from *C. ascheri* in that it is essentially much larger, being at least twice the size of the latter; has only one visible row of nodes, of which there are fewer per row than in *ascheri*; its fine spiral threads are wider apart while the growth lines are finer and more opisthocyrte than those in *C. ascheri*.

Cimolithium komarensis Pchelincev, 1927 (pl. 4, fig. 32) from the Lower Albian of the Crimea, is based on a fragment of two whorls, which show an angular basal edge and a row of small subsutural tubercles. It is therefore impossible to make any useful comparison with this almost indeterminate specimen.

Cimolithium aff. *elaneorae* Allison, 1955

(Pl. 2, fig. 5)

MATERIAL. BM(NH) G 74550. Cenomanian, between Charlton Bay and Culverhole Point, E. Devon.

DESCRIPTION. Medium-sized shell; high-spined, slender and turriculate, linear adpressed suture, which, appears to undulate as it abuts against axial ribs of the previous whorl. Whorl outline flat. The early whorls are not preserved. On later whorls, a series of about twenty elongated tubercles occurs just below the adapical suture and these have interspaces greater than their width. The tubercles form a slight astragal, which is approximately a quarter of the whorl height. The remainder of the whorl is ornamented by a smaller number of axial ribs and numerous very fine spiral threads that are at least twice the width of the interspaces between them. The axial ribs increase in number on successive whorls, some coincide and join with the adapical tubercles but the majority alternate with them, taper posteriorly and stop short. These ribs are slightly opisthocline, with the odd one markedly so. They are irregularly spaced and occasionally two occur very close together, only separated by a growth line. The growth lines are opisthocyrte. The base of the whorl is convex, but its ornament is not preserved, although the growth lines can be seen to curve narrowly forward and down on to the short anterior canal. The aperture appears to be ovate. Measurement of this partly worn and incomplete specimen has not been considered worthwhile.

DISCUSSION. There is a distinct resemblance between this specimen and *Cimolithium elaneorae* Allison, from Mexico. However, the British Cenomanian fossil has

a more acute spire than the Mexican specimen and also lacks its abapical angular whorl edge. In addition, its whorl sides are undoubtedly flat and axial ribs appear to be present on all whorls. Unfortunately, incomplete preservation prevents any exact comparison of the number of tubercles, ribs and spiral threads, or the extent of the anterior canal, although the aperture is ostensibly similar. *Cimolithium miyakoense* Nagao (1934) would seem to be rather broader than *C. aff. eleanorae* and its axial ribs are lost on later whorls, while it also possesses a series of tubercles abapically on the body whorl. The variety *C. miyakoense tomasensis* Allison (1955) lacks the adapical row of nodes and is also broader.

Cimolithium belgicum (Münster) 1844, (fig'd. Cossmann 1906 : pl. 14, figs 2-3 bis) can be distinguished from *C. eleanorae* by a lack of axial ribbing on the later whorls and also by being somewhat broader.

?Genus **RHABDOCOLPUS** Cossmann, 1906

TYPE SPECIES. By original designation, *Melania scalariformis* Deshayes, (1830 : 427); figured by Eudes-Deslongchamps, (1842; pl. 11, fig. 63).

DISCUSSION. As yet, it has not been possible to assign the species of Procerithiidae described below to any recognized genera with any certainty.

In some respects their ornament is similar to that of the Bajocian species *Cerithium millepunctatum* Deslongchamps, 1842 from Bayeux, included in *Procerithium* by Cossmann (1906 : 25), but apart from this general resemblance, the rounded aperture and the stratigraphical occurrence of this latter genus, ends any further comparison.

Cossmann (1906 : 57) included one of these species, *Cerithium forbesianum* d'Orbigny, in his original description of the genus *Uchauxia*. Yet, accepting that *Uchauxia* has a rounded aperture and a short anterior canal, the aperture present in *forbesianum*, although rounded, shows no indication of a canal, nor of the irregular varices which also characterize that genus.

Ornamental similarity, again invites comparison with the Cenomanian genus *Voysa*, described by Stephenson (1952 : 169, pl. 39), which he referred to the family Cerithiopsidae. The concave trend of the growth lines on the upper part of the whorl is analogous to that present in the species mentioned here, but although there is a considerable variation in both ornament and form of the species ascribed to *Voysa* not one possesses a whorl outline or a grooved suture that is exactly comparable to those of either *Cerithium clementinum* or *C. forbesianum*.

Among genera included in the Procerithiidae, the various features shown by members of the genus *Rhabdocolpus* Cossmann, 1906, bear the greatest likeness to this Cretaceous material. [*Rhabdocolpus* is considered a separate genus following Haas (1953 : 233), rather than a subgenus of *Procerithium* as originally proposed by Cossmann (1907 : 27)]. However, the distinctive ornament of *Rhabdocolpus* described by Haas, consisting of dominant axial ribs and an adapical 'coronet' formed by the tubercles on the adapical ends of the ribs, would appear to deter any further comparison. In his investigations of Peruvian Triassic material, Haas distinguished two groups within members of *Rhabdocolpus* and it is possible to make a similar distinction between later Mesozoic representatives. One group consists of

slender shells typified by the Kimmeridgian *R. quehenensis* (de Loriol) and another is comprised of those forms with more rounded whorls and opisthocline axial ribs that are comparable to the Bajocian *R. undulatus* (Eudes-Deslongchamps).

Such morphological diversity occurs in later forms and contributes to the difficulties experienced in classifying them, e.g. Cossmann (1906) was not satisfied with his own assignation of several species to the genera he recognized in the Procerithiidae. Similarly, the controversy over the recognition of some Upper Jurassic and Lower Cretaceous marine and brackish water forms as Melaniidae, or Procerithiidae (see Arkell, 1941 : 95-100 and Huckriede, 1967 : 188-189) provides further evidence of this difficulty in their determination. It would seem that a greater variety than hitherto suspected, occurs within the forms referred to as *Rhabdocolpus* and that the existence of these groups awaits determination. Further investigation will probably lead to these sub-groups being accepted as sub-genera.

The ornament of *C. clementinum* d'Orbigny, Forbes could be derived from that of the Bajocian *P. (R.) granulatoscostatum* (Münster), figured in Cossmann, (1913 : pl. 4, figs 11-12). The predominance of spiral over axial ornament seen in ?*R. forbesianum*, first occurs to a lesser extent in *R. manselli* (de Loriol), which suggests that this species may be an ancestor of *forbesianum*. This dominance of spiral ornament caused Haas to doubt whether *R. manselli* belonged to *Rhabdocolpus*.

Finally, the occurrence of at least two and possibly three species, of ?*Rhabdocolpus* at one horizon in the Lower Greensand [Crackers], requires further consideration and palaeoecological interpretation.

Haas, after investigating South American Triassic material, concluded that the relationship of the genera *Protofusius*, *Paracerithium* and *Rhabdocolpus* is much closer than that implied by Cossmann's classification, although as he pointed out (pp. 212 & 293), their exact position can only be discovered from a thorough investigation of all Triassic Procerithiidae. He showed that the morphological changes occurring in these genera, particularly in their ornament, could be interpreted as a series, with *Rhabdocolpus* the most highly specialized of the three. However, the evidence and determination of the earliest representatives of these genera is confusing and such a lineage remains doubtful. A further complication is the close resemblance, especially of ornament, of *Rhabdocolpus* to the Triassic genus *Andagularia* Haas, which is considered to belong to the Purpurinidae.

?*Rhabdocolpus* ?*clementinum* (d'Orbigny)

(Pl. 5, figs 6, 12 & 13)

?1843 *Cerithium clementinum* d'Orbigny: 357, pl. 228, figs 1-3.

1845 *Cerithium clementinum* d'Orbigny; Forbes: 352, pl. 4, fig. 9.

MATERIAL, LOCALITY AND HORIZON. BM(NH) GG 5692-5694, GG 20841-20843, GG 20844 (5), Crackers, Lower Greensand; GG 5708 (5 specimens), Lower Lobster Bed, Lower Greensand; Atherfield, Isle of Wight.

DESCRIPTION. A very small, turriculate shell with a narrow spire, flat-sided whorls and a grooved linear suture. The whorls are ornamented by 16-20 axial ribs,

that are orthocline on the early whorls but soon become strongly opisthocline. Generally, five primary spiral cords are visible on the whorl side, with occasionally a secondary cord between the second and third. Small rounded tubercles occur at the intersections of the axial ribs towards the base of the whorl; these tubercles become somewhat rectangular on the abapical cords.

The base is convex and has a varying number of spiral cords ornamenting its surface, although there are always a pair of primary cords forming small carinae some distance from the periphery and another pair of strong cords close to the columella. The entire semi-rounded aperture is flat at its base and has a straight inner lip.

In complete specimens, the growth lines are visible on the body whorl and these are initially strongly prosocline, but at the second spiral cord swing back to become strongly opisthocline, producing a rather asymmetric opisthocyrt shape.

DISCUSSION. Unfortunately, it has not been possible to discover Forbes' original specimen in the Geological Survey Collection. The various specimens from the same locality listed above, bear a strong resemblance to his figure of a turriculate, gastropod with cancellate ornament. Judging from the specimens in the British Museum (Natural History) collection, it would appear that in his figure, the ribs are too numerous, and that the dimensions of the whorls are incorrectly drawn.

The only other figures of *C. clementinum* are those given by d'Orbigny (1843 : 357, pl. 228, figs 1-3) and these do not show the typically cancellate and tuberculate ornament of the British specimens. D'Orbigny's figures show smooth cords and ribs that are orthocline, or only opisthocyrt rather than the strongly opisthocline ribs of the British Aptian fossils. In fact, d'Orbigny's figure could equally as well be interpreted as an attempt to represent the ornament of *C. forbesianum* d'Orbigny [= *C. phillipsi* Leymerie of Forbes].

Wollemann (1900 : 169) suspected that Forbes' Aptian fossil was not identical to those described by d'Orbigny from the Neocomian of Marolles (Dept. d'Aube), although he did not explain his doubts. In his description of *C. clementinum*, he mentioned that the axial ribs of subsequent whorls are irregularly alternate and that the whorls are convex, while he described the aperture as being quadrangular and depressed. Such a description could not be applied to the specimens referred here to Forbes' 1845 figure.

It is not advisable to introduce a new specific name for the British material, until d'Orbigny's material has been re-examined and his types recognized. Peron (1900 : 192) commented that the ornament of *C. clementinum* is extremely variable and that the specimen figured in the '*Paléontologie française*' is a very rare form.

? *Rhabdocolpus forbesianum* d'Orbigny, 1850

(Pl. 5, figs 1-5)

1845 *Cerithium phillipsi* Leymerie; Forbes: 352, pl. 4, fig. 12.

1850 *Cerithium forbesianum* d'Orbigny: 116

1854 *Cerithium forbesianum* d'Orbigny; Pictet & Renevier: 52, pl. 5, fig. 6.

1864 *Cerithium forbesianum* d'Orb.; Pictet and Campiche: 286.

1868 *Cerithium forbesianum* d'Orb.; Verneuil & Lorient: 15, pl. 2, figs 7a-e.

1906 *Uchauxia forbesiana* (d'Orb.); Cossmann: 57 & 252.

1961 *Uchauxia forbesiana* (d'Orb.); Casey: 607.

MATERIAL AND OCCURRENCE. Four specimens in the collections of the Geological Survey Museum have been accepted as the original material in the Geological Society Collection that was described by Forbes (1845) as *C. phillipsi*. Two of the specimens bear the Geological Society number 2267 and the other two are associated with a label numbered 2275 and all are from the Lower Greensand of Atherfield, Isle of Wight. Blake (1902) lists R 2267 in his catalogue of type material at the Geological Society and, it is true, that a specimen with this number in a small rock fragment, bears ornament similar to that shown in the original figure on Forbes' plate 4. However, not one of these specimens is exactly like the figure, which is probably a composite representation of the features shown by these incomplete and poorly preserved specimens. This material must, therefore, be accepted as a type series and one of them, GSM Geol. Soc. 2275 (a)—an incomplete specimen but clearly showing the ornament of later whorls,—is selected here as a lectotype.

I have used better preserved, topotype material from the Crackers, Lower Greensand, in the British Museum (Natural History) collections to describe this species; GG 20845-20849, GG 20850 (6), GG 5609, GG 5695-5697, G 20898 and G 20908. Another specimen G 20983 comes from East Shalford in Surrey, an Atherfield Clay locality mentioned by Casey (1960 : 547).

DESCRIPTION. A very small shell (on average 2-4 mm in height), composed of convex whorls that are separated by a grooved linear suture; in the early whorls the suture may appear to undulate owing to the effect of the axial ribs. The ornament of the early whorls is quite different from that of the later whorls. Initially, ornament consists of several spiral cords and 10-14 opisthocline axial ribs, with slight tubercles occurring where the cords cross the ribs. After 3 or 4 whorls the axial ribs disappear but continue to influence the cords, first as the tubercles briefly persist and then by producing slight crenulations and, or, thickenings in the smooth ribbon-like spiral cords. On later whorls, six raised-primary cords are generally visible but some variation in this number occurs. Frequently, the third and fourth cords from the adapical suture are the strongest and these occur at the centre of the whorl. In other examples, the strongest cords occur towards the abapical suture with the weakest on the adapical shelf. The interspaces between the spirals are considerably wider than the width of the cords. Secondary cords develop in these interspaces, but not according to any definite pattern.

The rounded base is ornamented by a varying number of spiral cords with a primary cord close to the periphery and two other primary cords close to the columella. Growth lines are only visible on the whorl sides as striae between the cords, but they are easily seen on the base and swing back towards the columella.

The semi-rounded aperture is entire, has a flat basal lip, a thin outer lip, straight inner lip and a smooth columella.

DISCUSSION. Several authors have followed d'Orbigny and used the name *forbesianum* to describe this British Aptian fossil, but few have endeavoured to

distinguish it from *Cerithium phillipsi* Leymerie 1842. D'Orbigny first used the name *forbesianum* in his Prodrôme (1850 : 116) when recording the British material, which he considered Forbes had misidentified, but did not provide any detailed explanation. Pictet and Campiche (1864 : 287) suggested that the slender elongate form of both species may have led to the confusion, but commented that the rare varices that occurred in *C. phillipsi* provided an easy method of distinguishing the two species. These varices are easily seen in d'Orbigny's figure of the French species (1843 : pl. 227, fig. 10) but are not shown in Leymerie's own figure (1842 : pl. 17, figs 11a & b) of this more elongate shell. Verneuil and Lorière (1868 : 15) recognized that *C. forbesianum* was quite different from *C. phillipsi* and provided the only adequate figure (pl. 2, figs 7a-e) of the species to show its variable ornament, when describing its occurrence at several localities in the Aptian of the Spanish province of Teruel.

Cossmann (1906 : 57) obviously accepted, or also observed, the varices in *C. phillipsi* Leymerie, for he included the species in his new genus *Uchauxia* in which the possession of varices is a diagnostic feature. Yet, this evidence still needs to be verified by examining type material, and, in order to ensure that *phillipsi* does belong to *Uchauxia*, it is also necessary to ascertain that an anterior canal is present for one has not been figured. At the same time, Cossmann (1906) referred *C. forbesianum* to *Uchauxia* commenting that it was close to *phillipsi* and quoted Pictet as his source. The only figure produced by Pictet is that in Pictet and Renevier (1854 : pl. 5, fig. 6) which depicts a shell with ornament between that of *forbesianum* and *phillipsi* [as understood from the figures quoted above]. However, the presence of an entire aperture in several of the British specimens of *forbesianum* listed above, shows that this species cannot belong to *Uchauxia* (as interpreted by Cossmann, 1906).

The turreted and flat-sided whorls of *C. clementinum* d'Orbigny; Forbes, together with their persistent cancellate ornament, easily distinguish this species from the differently ornamented *forbesianum* with its strong spiral cords and convex whorls. Yet both have several features in common, such as a grooved linear suture, and a semi-rounded entire aperture, while their early whorls can be confused if the ornament is not adequately preserved.

The greater convexity of the whorls and their persistent orthocline axial ribs distinguish *C. dupinianum* d'Orbigny (1843 : 357, pl. 227, figs 4 & 5) a similar species to *forbesianum*, described from the Neocomian of Marolles (Dept. d'Aube).

? *Rhabdocolpus melvillei* sp. nov.

(Pl. 5, fig. 7)

DIAGNOSIS. A small procerithiid with reticulate ornament on its early whorls but which loses axial ornament on later whorls, and has a wider spiral angle than usual in the genus.

HOLOTYPE. In the Sedgwick Museum, B. 27340.

OTHER MATERIAL. Four paratypes in the Sedgwick Museum, Cambridge, B. 27341-27344, all belonging to the Wiltshire Collection.

LOCALITY AND HORIZON. Crackers, Atherfield Clay Series, Lower Aptian, Forbesi Zone, near Atherfield Point, Isle of Wight.

DESCRIPTION. The shell is very small and has a wide spiral angle. The whorl outline is strongly convex and the suture impressed. The earlier whorls show about twelve opisthocyrt axial ribs. On later whorls, three spirals appear and small rounded tubercles are developed where these intersect the axials. Later, a gap develops between the first and second spiral cords and two further cords are produced on either side of the first. The new spirals eventually become as strong as the earlier formed ones. On the body whorl, the spirals are separated by interspaces greater than their width and the axials are separated by interspaces greater than those between the spirals. The rounded base is ornamented by several less-tuberculated spiral cords.

DISCUSSION. This species can be distinguished from ? *R. forbesianum* by its more strongly-rounded whorl outline, by its greater number of axial ribs, slightly stronger development of tubercles and wider spiral angle. The few specimens of ? *R. melvillei* that are available do not show any indication of secondary spirals between the primaries, nor the marked differentiation in ornament that occurs in *forbesianum*. However, the full range of variation within *forbesianum* is not known and it could be possible that ? *R. melvillei* is, merely, a variety of that species.

Family ? PROCERITHIIDAE

Genus ? *UCHAUXIA* Cossmann, 1906

TYPE SPECIES. By original designation Cossmann (1906 : 56), *Cerithium peregrinorsum* d'Orbigny 1843, from the Turonian of Uchaux, Vaucluse, France.

DISCUSSION. The material described below, undoubtedly belongs to a common genus and because of considerable similarity in form and ornament to species of *Uchauxia*, they are regarded as belonging to that genus. However, owing to their incomplete preservation this determination must remain provisional.

The genus *Uchauxia* is also subject to uncertainty, for a crucial factor in its recognition is the apertural shape of its type species, *U. peregrinorsa*. The various figures of that species provided by d'Orbigny (1843 : pl. 231, fig. 3), Cossmann (1906 : pl. 6, figs 37-40) and Roman and Mazeran (1920 : pl. 5, figs 42-44) do not provide sufficient reliable evidence of this feature, although each author mentions a rounded aperture with a short anterior canal in his description. In order to verify these features it is necessary to refer to the type material. Unfortunately, this has not been possible during this investigation, nor have other specimens of the species been available for comparison.

For the moment, following Cossmann (1906 : 57), it is assumed that these small Cretaceous shells are fully grown and that they resemble *Procerithium* and *Rhabdocolpus*, but have a distinct, short anterior canal.

Uchauxia, as here understood, is generally larger than *Cerithiopsis* Forbes & Hanley but does have a similar whorl shape and tends to have the same range of ornament. *Cerithiopsis*, however, usually has a more advanced type of siphonal canal, which

does not project above the basal plane and resembles a keyhole in basal view. Cossmann (1906 : 57) pointed out that *Uchauxia* only occurs in strata that are believed to be entirely marine and for this reason, differs from both *Potamides* Brongniart 1810 and *Pirinella* Gray, 1847.

Uchauxia wisei sp. nov.

(Pl. 6, figs 5 & 6)

DIAGNOSIS. *Uchauxia* with four prominently beaded spirals, the abapical penultimate spiral being weaker than the others, and weakly developed axial ornament.

HOLOTYPE. BM(NH) GG 6161, C. W. Wright collection.

OTHER MATERIAL. Eight Paratypes BM(NH) GG 5611, GG 6158-6160 & GG 6162-6165. C. W. Wright collection. All incompletely preserved.

LOCALITY AND HORIZON. Claxby Ironstone, Valanginian-Hauterivian, Nettleton, Lincs.

DESCRIPTION. The shell is small, narrow and turriculate, slightly cyrtocoid, with a flat-sided whorl outline and linear suture. On the earlier whorls, three primary spiral cords are developed with interspaces of equal width. The anterior and posterior spirals become more prominent on later whorls, with the central spiral moving posteriorly as a secondary spiral cord makes its appearance abapically to it. A secondary spiral is also developed behind the posterior primary spiral. On still later whorls, a secondary spiral cord may appear between the two posterior primary spirals. The spirals cross 20 to 24 axial ribs, producing rounded tubercles at each intersection. The axials are separated by interspaces almost equal to their own width and are orthocline on the early whorls but become opisthocyrt.

The base is convex and bordered by two spiral cords; the axials do not extend on to it and the surface is almost smooth. The small, oval aperture has a curved anterior canal. The growth lines follow the axial ridges.

DIMENSIONS. Holotype BM(NH) GG 6161.

Height (approx. 5 whorls)	. . . . .	10.0 mm
Spiral angle	. . . . .	12°
Penultimate whorl height	. . . . .	1.8 mm
Penultimate whorl diameter	. . . . .	3.8 mm

DISCUSSION. The most characteristic feature of this species, when compared with other species of *Uchauxia* that have four spiral cords, is the weak influence of any axial component. In the Turonian type species, *U. peregrinorsa*, the axials are quite strong, and similarly, in the Gosau species *U. solida* (Zekeli, 1852 : pl. 20, fig. 3) and *U. distinctum* (Zekeli, 1852 : pl. 19, fig. 6), the exact age of which needs to be investigated (see Kuhn, 1947 : 188).

U. wisei is distinguished from the two species described below, in that *Uchauxia* sp. nov. has only three spiral cords of tubercles ornamenting the whorl and that its tubercles have some axial alignment; while the prosocline axial ornament of *U. badri* is quite diagnostic.

The specimen described by Roman & Mazeran (1920: pl. 5, fig. 45) as *Uchauxia richei*, although having predominantly spiral ornament, has many more cords, which have a lower degree of tuberculation, than *U. wisei*. Originally, their specimen was figured by Cossmann in his examples of *U. peregrinorsa* and it may still be found to come within the range of variation of that species, when this aspect is fully investigated.

Although the figures of the type species in both Cossmann (1906) and Roman & Mazeran (1920) are inadequate for exact comparison, it is possible to decide that *peregrinorsa* (d'Orb.) has several more tuberculate spirals than this specimen of *U. wisei*. The Turonian species described by Roman & Mazeran, *U. richei*, has three granular cords but possesses many more primary cords and has a slightly different whorl outline.

The British Museum (Natural History) collection included a number of *Ageria gaultina* sp. nov. from the Gault of Folkestone, which at first sight, have some resemblance to this fossil but the existence of a greater number of axial ribs and a differing growth line pattern provide adequate distinguishing characters.

Uchauxia badri sp. nov.

(Pl. 6, figs 3 & 4)

DIAGNOSIS. A small, slender, cyrtoconoid, turriculate shell that is ornamented by four tuberculate spiral cords, the tubercles of which are aligned along prosocline axial ribs, giving a distinctive twisted appearance to the shell.

HOLOTYPE. Sedgwick Museum, Cambridge, B 44632.

HORIZON AND LOCALITY. Upper Greensand, Albion, Blackdown, Devon.

DESCRIPTION. A small cyrtoconoid shell with a slender turriculate spire. The whorl outline is slightly convex and the shell has a grooved linear suture. The ornament of the earlier whorls is dominated by strong axial ribs which cross three unequally-spaced spiral cords. On subsequent whorls, the number of cords increases to four and eventually five, producing rounded tubercles at their intersections with the axial ribs. The ribs consequently become less dominant and contribute to the cancellate effect of the ornament. The interspaces between the spiral cords are then equal and also equal to the width of the cords but considerably narrower than the spaces between the axial ribs. The prosocline axial ribs are partly offset in relation to one another on subsequent whorls and this gives a twisted look to the shell. On later whorls, these ribs become reduced in strength, although this may, in part, be due to wear and poor preservation. On the penultimate and body whorl, it is also possible to see the fifth spiral cord, which occurs close to the abapical suture. The axial ribs influence this, but although they may cross it, they then weaken towards the suture.

The convex base is covered by faint collabral threads and ornamented by five spiral cords, two of which produce small carinae. The small rounded aperture has a partly twisted anterior canal.

DIMENSIONS. Holotype, Sedgwick Museum, B 44632.

Height	10.6 mm
Mean spiral angle	20°
Height of last whorl	3.0 mm
Maximum diameter	2.9 mm

DISCUSSION. The distinctive prosocline axial ribs, that give the ornament of this species a slightly twisted look, have been mentioned in the discussion of the preceding species. It is this feature that immediately distinguishes *U. badri* from the type species *U. peregrinorsa* despite the figures of the latter being unsuitable for any further detailed comparison. However, it is also possible to observe that the axial ribs of *peregrinorsa* are opisthocyrt and that its spiral cords are much thinner (i.e. weaker) than those of *badri*.

One of the Lower Cretaceous species, *forbesianum* (d'Orbigny), that Cossmann included in this genus, is now thought to belong to *Rhabdocolpus* Cossmann, 1906. There is still some confusion concerning the characters of *U. phillipsi* (Leymerie) and as suggested elsewhere in this paper, type material needs to be re-examined in order to verify the validity of Cossmann's determination. The ornament shown in the few figures of this slender species is quite different from *U. badri*, but Leymerie's figure (1842, pl. 17, figs 11a & b) although not showing varices, does show orthocline axial ribbing.

Cerithium kaunhoweni Cossmann (1902 : 61), from the Maastrichtian of Maastricht, differs in that, although having cancellate ornament, this is much finer and composed of at least 6 untuberculated spiral cords and numerous opisthocyrt axial threads, while the shell also has a definite anterior canal. *Cerithium distinctum* Zekeli (1852: pl. 19, fig. 6) from Gosau, although having four predominate tuberculate cords between the sutures, also has a thin cord in the centre of each interspace and has strongly orthocline axial ribs.

Uchauxia sp. nov.

(Pl. 6, fig. 7)

MATERIAL AND LOCALITY. BM(NH) G 73788 J. S. Gardner Collection, Gault, Folkestone, Kent.

DESCRIPTION. Unfortunately, this unique specimen is rather crushed and measurements are not reliable, but it has been possible to discover details of the ornament by developing out its reverse side. This gastropod can be described as a small, more or less subulate, slender shell with convex whorls. Its moderately deep, linear suture lies at the bottom of a concave furrow formed by adjacent whorls. The initial whorls show bicarinate ornament, but a third spiral cord soon appears just behind the posterior of the two initial cords, and others develop later. These spiral cords are separated by wider interspaces and each interspace is occupied by at least one almost smooth spiral thread. The primary cords are tuberculate and the rounded tubercles are separated by intertubercular spaces that are nearly equal to their width. Usually these are of the same number and strength on each cord, but sometimes those on the posterior cord are slightly weaker. On the early whorls, the

axial ridges are as dominant as the spiral cords, yet, later, with the increase in size of the whorl they appear to become slightly disrupted and if there is any connection at all, only a thin curved ridge joins the tubercles. These ridges tend to follow the opisthocyrt growth lines. Towards the base the whorl flattens repeatedly; first to a serrated cord making a slight carina and then again to another smooth cord. Only the former is visible on previous whorls and would appear to mark the periphery of the whorl. Traces of a short columella and an aperture with a short, shallow anterior canal are present.

DISCUSSION. Cerithiaceans with this general form are common amongst both European and American gastropods and include many marine and non-marine species. However, the Cretaceous age of the specimen and its occurrence in an undoubtedly marine deposit, prompt its inclusion in the genus *Uchauxia*.

The ornament of the specimen serves to distinguish it from both *U. wisei* and *U. badri*. It differs from *wisei* in the number of spiral cords and their interspace width, while the possession of fewer tubercles on each cord and the stronger axial ridges emphasize the differences between the two species. The more reticulate pattern produced by cords, tubercles and ribs, assists in separating it from *badri*, although it is the markedly prosocline ribs of the latter which separate the two species and which give *U. badri* a slightly twisted look.

Family CERITHIIDAE Fleming, 1828

REMARKS. Cossmann (1906) discussed the relationship of the Procerithiidae and the Cerithiidae (p. 20-21) and the derivation and evolution (p. 60-61) of the very prolific Cerithiidae in detail. He concluded that the anterior canal was the most important diagnostic character in separating the two families, even though the form of the canal was extremely variable within the Cerithiidae and that the demarcation between the subcanaliculate beak of the Metacerithiinae and the truncated canal of the Potamidiinae would appear to be very slight but quite distinct. In his view, the two families can easily be separated by the character of the canal, for even in the most truncated cerithiid the anterior canal always forms a slight ridge or projection beyond the surface of the base, while conversely, the beak of the Procerithiidae never protrudes below the base of the shell. In the Cerithiidae the canal is also generally twisted.

Although Cossmann was satisfied that the Cerithiidae were derived directly from the Procerithiidae, it is possible that they may have arisen from the Jurassic family Eustomidae (see Cossmann, 1906 & 1913). Members of this family, consisting of the two genera *Diatinostoma* and *Ditretus*, possess a well-marked, but straight, cerithiid-like canal and generally occur in the coral-rudist assemblage at horizons from the Bathonian to the Turonian, (see Cossmann 1906 : 12-14). If this alternative should prove to be correct, the relationship of the Cerithiidae with holostomatous forms might be further apart than Cossmann suspected. On the other hand, the apparent relationship may be explained by homeomorphy.

It is particularly noticeable that from Upper Cretaceous to Recent times, the members of the Cerithiidae have frequently been associated with corals. In the

Cretaceous, the richly coralline areas occurred further to the South and consequently, the British record of the Cerithiidae at this time is very sparse. The available evidence, which undoubtedly suggests that the Cretaceous was a period of experimentation within the family, represents differing degrees of specialisation of the entrance to the mantle cavity and of the anterior siphon. It is interesting to note that typical holostomatous procerithiid forms also occurred at these times but only persisted until the end of the Cretaceous.

Sub-family ? **CAMPANILINAE** Wenz, 1940

Genus ? **CAMPANILE** Bayle (in Fischer), 1884

? *Campanile cenomanica* sp. nov.

(Pl. 6, figs 1 & 2)

DIAGNOSIS. High, conical shell with whorls ornamented throughout by an adapical carina and three prominent spiral cords; the twisted columella lacks any folds.

MATERIAL AND OCCURRENCE. BM(NH) GG 18686; its history not certain, for although the original label states 'Chalk Marl, Craie Chloritique, Dorset' and gives the registered number 73597, the information in the register given with that number could not appertain to this particular specimen. Its preservation does suggest that it may come from the Cenomanian of Dorset, yet efforts to find similar material both in collections and in the field have not been successful.

DESCRIPTION. Unique turreted, conical, slender shell of medium size that is not completely preserved. Flat whorls, having straight whorl outline with a slight adapical shoulder. Adpressed linear suture. Whorl ornament characterized by a high adapical astragal with a rounded edge and bearing beads that are separated by intervals equal to their own width. Three prominent spiral cords are equally distributed below this and in each interspace there is a faint spiral thread. The central cord is somewhat weaker. Beaded ornament gradually develops on the astragal and on the cords. A fourth, but smooth spiral cord can be seen at the basal edge of the penultimate whorl. This cord marks the limit of the shallow convex base, ornamented by numerous equally spaced spiral cords.

The spiral ornament is crossed by frequent opisthocyrt growth lines, which straighten a little towards the abapical suture, but after crossing on to the base, curve forward and then finally swing back towards the columella. At intervals corresponding to the occurrence of the beaded tubercles, and following the growth lines, there is a slight alteration in the growth direction of the shell.

The poorly preserved aperture is not large in proportion to the remainder of the whorl, as in some species of *Campanile*. It shows a slightly twisted columella with a distinct anterior canal and has a callused parietal lip. There are indications of a small posterior 'gutter' or neck, and the form of the outer lip cannot be interpreted with any certainty.

DISCUSSION. The apertural features shown by this specimen, undoubtedly, indicate a strong affinity with the Cerithiidae. Its ornament and general shell morphology are comparable to those of the genus *Campanile*. However, the

apparent atypical growth lines, the shorter anterior canal and lack of columella folds could be interpreted as an indication that it would be better placed in the Cerithiinae. Yet, on referring to the literature, one recognizes that the features generally accepted as those of *Campanile*, because of its Eocene type species *C. giganteum* (Lamarck) 1804, are only one end of the range occurring within that genus. In fact, another Eocene species *C. cornucopiae* (J. Sow.) 1818, is basically very similar to the British Cretaceous specimen, having a sub-rhomboidal aperture, a small twisted anterior canal below a callused parietal lip, initially a flat whorl outline, a linear suture and the same slight straightening of the opisthocyrt growth lines. The presence of two columellar folds is the only difference between the two species.

Two Maastrichtian species from Iran described by H. Douville (1904 : 312, pl. 43), *C. morgani* and *C. breve* show the rather simpler ornament of *C. cenomanica*. Another Maastrichtian species *C. carezi* Vidal, (1917; 7, pl. 3, fig. 6) from Sensui, Spain, has the typical coronet ornament of later species of *Campanile*. All of these, however, possess the distinctive columellar folds of the genus.

Whether the British fossil is a juvenile, the early whorls of an incomplete specimen, or an early form of the genus *Campanile*, remains to be discovered. It certainly does not show the characteristic two fold ornament that develops in Tertiary species of the genus. More material is also necessary before one can attempt to investigate its relationships with other Cretaceous species, or to make any conclusions as to its possible position in the evolution of the campanilids. Cossmann recognized that the genus first appeared towards the end of the Cretaceous, but *C. cenomanica*, if correctly identified, would probably place their origin farther back than he suspected.

Genus *EXECHOCIRSUS* Cossmann, 1906

TYPE SPECIES. By original designation, Cossmann (1906 : 121), *Cerithium cingillatum* Zekeli, 1852 (pl. 18, fig. 6), from the Upper Cretaceous of Austria.

DESCRIPTION. Moderate-sized shells with weakly convex to flat-sided whorls. Distinct adpressed suture, often undulates and is occasionally grooved. Ornament extremely variable in size, strength and pattern, both within the genus and within species; consists basically of tuberculate spiral cords and axial ribs. Adapical ornament frequently prominent and separated from the remainder. Opisthocyrt to opisthocline growth lines. Genus is characterized by the presence of a prominent varix diametrically opposite the aperture on the body whorl. In some species, varices occur on earlier whorls but these are never aligned as in other Cerithiidae. A varix thins towards the adapical and abapical sutures. Small, low, rounded to quadrangular aperture with a short anterior canal and a weakly developed adapical 'gutter', or channel. Smooth, curved columella with callused inner lip; basal lip nearly flat, outer lip not expanded outwards.

DISCUSSION. Cossmann (1906 : 121) considered *Exechocirsus* a subgenus of *Tympanotonus* Schumacher, 1817 on account of some similarity in ornament, but more particularly, because of their apertural characters. However, despite these

resemblances it would seem reasonable to reserve the genus *Tympanotonus* for non-marine gastropods and to place the marine *Exechocirsus* in a separate genus.

Exechocirsus also has certain similarities with other Upper Cretaceous and Lower Tertiary cerithiid genera, e.g. *Theridium*, *Clava* (*Clavocerithium*), *Clava* (*Pseudovertagus*), *Serratocerithium* and *Teliostoma*. There is a common element in shell shape, size and in ornament patterns (in many cases varices occur at intervals), while apertural features are also alike. Further studies may show that *Exechocirsus* is a precursor of these genera and probably of other groups of the Cerithiacea such as *Potamides* and even *Cerithium* itself. Certainly, from amongst the few Cretaceous cerithiids, *Exechocirsus* appears to be the most likely ancestor for many of the Tertiary forms and this warrants its consideration as a separate genus. The possession of essentially cerithiid characters suggests inclusion in the sub-family Cerithiinae (Cerithiidae) rather than to accompany *Tympanotonus* in the Potamididae.

Přehelincev (1953 : 192) has attempted to explain the strong and varied ornament occurring within the genus, by suggesting that it probably increased the mechanical stability of the shells and he cites their prolific occurrence at Gosau, in company with thick shelled Opisthobranchs and *Nerinaea*, as evidence.

With regard to the type species of the genus, *Cerithium cingillatum* Zekeli, it is possible that this may be the early whorls of *Cerithium pustulosum* J. de C. Sowerby, 1835, a species which is also recorded from the Upper Cretaceous at the same locality (Gosau, Austria).

Exechocirsus saundersi (Woods)

(Pl. 7, figs 3-5)

1896 *Cerithium saundersi* Woods: 92, pl. 4. figs 12 & 12a.

1921 *Cerithium saundersi* Woods, Ravn: 47.

HOLOTYPE. Sedgwick Museum, B 4459, Cuckhamsley, North Farnborough, Berks., Turonian, *Holaster planus* Zone.

OTHER MATERIAL. Chalk Rock, G 66724, Latimer, Bucks.; G 69915, Henley Quarry, ? Medmenham, Bucks; GG 20821, GG 20825-20826, Hitch Wood Pit (Hill End Farm), nr. Hitchin, Herts.; G 67704 H. *planus* Zone Dover; G 11523 Missenden, Herts.; GG 20829, Kensworth Quarry, Beds. Forbes (1960: p. 237) records a large specimen from H. *planus* Zone, Western Colville, Cambs., SM. B 81559.

DESCRIPTION. Medium-sized, slightly elongate shell with almost flat-sided whorls. Distinct impressed linear suture, which owing to the shell ornament appears to undulate a little. There are four equal spiral cords, with interspaces from one half to equal width between them. These cords are ornamented by rounded tubercles, which are longitudinally aligned, occur at the junctions of the cords and ribs and conform to the orthocline (or very slightly opisthocline) axial ribs. In general, the axial ribs number about sixteen per whorl, but this varies according to growth, and their interspaces are equal to their width. There are a varying number of fine spiral threads between the tuberculated cords. In some specimens, a smooth

partly undulating cord occurs below the main spiral and just adapical to the suture. Woods had described and figured this, but in the holotype this cord appears to be composed of much smaller and more numerous tubercles (see pl. 7, fig. 5).

The base is flat to very slightly convex, has a sixth granular, sub-carinate cord near the border and numerous spiral threads crossing its surface. The aperture is only partially exposed but appears to be obovate to quadrangular. It shows a short, well-formed anterior canal that is slightly curved, a callused inner lip and a concave columella. A strong varix occurs opposite the aperture on the last whorl and in a few specimens, there are indications of others on earlier whorls.

DISCUSSION. The occurrence of a strong varix on the last whorl diametrically opposite the aperture is characteristic of the genus *Exechocirsus*. In his original description, Woods distinguished the new species from *C. pustulosum*, J. de C. Sowerby (1835: pl. 39, fig. 19) by its smaller spiral angle and fewer tubercles. Another feature is that the axial ribs are more definite; they are also opisthocyrt and only incorporate the tubercles of the lower three cords, those on the adapical cord remaining unconnected. The tubercles on the abapical cord become somewhat elliptical and on successive whorls they gradually diminish in size (see Zekeli, 1852, pl. 19, fig. 5). Finally, there are undoubtedly more longitudinal rows of tubercles, i.e. ribs, per whorl, in *E. pustulosum* (J. de C. Sowerby).

Cerithium pustulosum d'Orbigny (non Sowerby), 1843 resembles *E. saundersi* in ornament, but its longitudinal rows of tubercles are strongly opisthocline and are also said to be farther apart (Zekeli, 1852 : 100). In addition, the suture is grooved and the aperture more ovate.

Woods also separated *E. saundersi* from *C. pseudoclathratum* d'Orbigny, 1850 (as figured in Geinitz, 1874, pl. 31, fig. 5), yet, although the latter has similar ornament, its true generic position is uncertain. Sohl (1960 : 83) included *C. pseudoclathratum* with two American, Upper Cretaceous species that he has since (1964 : 364), mentioned as being closely related to *Cerithiella* Verrill, 1882.

The Upper Cretaceous, *Cerithium navasi* Vidal, 1917 from Sensui, Spain, is easily distinguished from *E. saundersi*, in only having three tuberculate spiral cords and a less prominent, finely-beaded, cord at the abapical suture.

It is difficult to decide the relationship of several British specimens which show slight differences from typical *saundersi* ornament, owing to the lack of knowledge of the range of ornament variation occurring in that species. In a number of these examples, the tubercles appear to be more numerous and this obscures any regular axial alignment that they may have.

Two undescribed, unlocalized specimens from the Sowerby Collection G 60542-60543, and others in material collected by C. W. Wright from Hitch Wood Pit, Hitchin, Herts. (GG 20822-20824) show distinctive features (see pl. 7, figs 8 & 9; 1, 2 & 12). Basically there is a stronger development of both primary and secondary spiral cords, while the axial ribs are fewer (12-14 per whorl) and consequently wider apart. Among other features, the adapical cord is separated from the others by a much wider interspace, the suture occurs in a groove formed between adjoining whorls and varices frequently occur on earlier whorls.

In BM(NH) G 67704, (pl. 7, fig. 4) from the Chalk Rock of Dover, some of the very earliest whorls are preserved. Initially, the whorls are ornamented by two tuberculate spiral cords, this eventually increases to three and within a further two whorls, to four. The spire in this specimen is considerably more slender than those of other species included in *Exechocirsus*. In another specimen, BM(NH) GG 20821, pl. 7, fig. 1) the tubercles are weakly developed but the axial ribs produce a rather longitudinal step-like appearance in the shell, which also has a more distinctive suture.

Other material BM(NH) GG 5932-5934, GG 5982-5983, GG 5987 and GG 5771 (see pl. 7, figs 13 & 14) collected by C. W. Wright, from the *Holaster planus* Zone at Kiplingcotes in East Yorkshire, is obviously related to *E. saundersi*. The slender shape of the shells, their markedly opisthocyrt growth lines and opisthocyrt (rather than opisthocline) ribs suggest they are a different form. Additional support to such a view, is provided by their intermediate spiral threads, which are stronger than in typical *saundersi* and by the fact, that in general, they are much smaller specimens. It is possible that these features are the result of a phenotypic response to differences in environment and for the moment, the specimens are regarded as *Exechocirsus* aff. *saundersi* (Woods).

? *Exechocirsus* aff. *subpustulosus* Pchelincev, 1953

(Pl. 7, figs 10 & 11)

1953 *Tympanotonus* (*Exechocirsus*) *subpustulosus* Pchelincev: 193-194, pl. 33, figs 13-16.

1960 *Tympanotonos* (*Exechocirsus*) *subpustulosus* Pchelincev, in Orlov, pl. 19, fig. 13.

MATERIAL. BM(NH) G 73798 and G 16134, Upper Greensand, Upper Albian, Haldon, Devon.

DESCRIPTION. Poorly preserved medium-sized turriculate shells with feebly convex whorls that have a very small adapical sutural ramp, a slightly grooved undulating suture and opisthocyrt growth lines.

The whorls are ornamented by about 18 narrow axial ribs, that are orthocline on the early whorls but rapidly become opisthocyrt. These ribs are separated by interspaces that are at least equal to their width. On the earlier whorls a narrow spiral groove cuts the ribs to produce an adapical row of tubercles. Other similar spiral furrows occur abapically to this, on later whorls, and these dissect the ribs even more, with the result that the original predominantly axial ornament becomes changed to a spiral pattern. A single spiral thread occurs in each groove. Numerous fine spiral threads can be seen in the interspaces between the ribs. Further spiral grooves occur towards the base on the last whorl. Neither the base of the shell or the aperture can be seen.

DISCUSSION. Lacking knowledge of apertural details and without any indication that these specimens possess the characteristic varix of *Exechocirsus*, it is not possible to refer them to that genus with certainty. They are provisionally referred to the Transcaucasian Cenomanian *Exechocirsus subpustulosus* Pchelincev (1953) on the basis of ornament resemblance. The axial ribs of *subpustulosus* are also dissected by spirals to produce four rows of tubercles and both species have a rounded base.

Although the adapical rows of tubercles is the most prominent and is also separated by a wide groove from the lower rows, it has fewer tubercles than that of the British specimens. Pchelincev remarked that there is a tendency for the ornament of *subpustulosus* to become weaker on later whorls and this effect is also apparent in the Haldon material. It is only the lack of varices on the earlier whorls, together with the narrow apical angle, that enabled Pchelincev to distinguish his species from *E. pustulosus* (J. de C. Sowerby).

Family ? CERITHIIDAE

Genus *AGERIA* nov.

Named in honour of Dr D. V. Ager, Professor of Geology at the University of Swansea, in recognition of his help and advice.

TYPE SPECIES. *Ageria gaultina* sp. nov.

DIAGNOSIS. Turriculate shells, ornamented by spiral cords and axial ribs; the cords are frequently beaded and the abapical cord is characteristically strongly developed and ornamented.

GENERIC CHARACTERS. Small-medium sized, slender, turriculate shells. Convex whorls with a slight concavity before an abapical astragal. Flush, slightly grooved, undulating suture. Regular ornament formed by axial ribs and spiral cords. In some species the axial ribs weaken on later whorls, but in all species they have a characteristic opisthocyrt shape. In most species, the primary spiral cords are beaded, but in some the cords are smooth. A strong cord forms a distinctive abapical feature which delimits the base. Opisthocline growth lines influence the spiral ornament and show a median sinus, they swing back towards the columella on the uniform basal slope. Axially elongate, quadrangular aperture and indication of a short anterior canal with a smooth, slightly curved columella.

DISCUSSION. The general shell shape and ornament, together with the slight indication of a short anterior canal, suggest that this distinctive group should be included in the Cerithiidae. Yet, the lack of adequately preserved material showing the aperture prevents a definite conclusion being formed; particularly as the indications of an anterior canal in the type species *A. gaultina* sp. nov., could be the result of crushing. Consequently, it is not possible to assign *Ageria* to a particular subfamily of the Cerithiidae. Furthermore, its similarity in ornament to the procerithiid genus *Cryptaulax* Tate, 1869 is noticeable and the possibility that *Ageria* could be derived from this cannot be dismissed.

In many respects, the generic characters resemble those found in members of the Turritellidae, i.e. the turreted shell, the whorl outline and the possession of a thin parietal lip with a smooth columella. However, the holostomous, sub-circular aperture of the Turritellidae makes any further comparison rather pointless, while the characteristic lack of axial ornament in that family together with the marked sinuosity of its growth lines and outer lip and the deeply excavate columella provide further distinguishing characters.

Two species that can now be referred to *Ageria* are *Turritella costata* J. de C.

Sowerby, 1827, Upper Greensand, Albion, Blackdown, Devon; and *Cerithium binodosum* Roemer in Frič (1894, text-fig. 87), Lower Senonian, Březno Beds (= Priesener Schichten) Březno, Czechoslovakia.

Questionably referred species are *Turritella angustata* d'Orbigny, 1850 from the Neocomian of France (see p. 158) and *Cerithium hector* d'Orb. (1850, p. 156) in Guéranger, 1867 (pl. 14, fig. 2), Cenomanian from Le Mans, France.

The original figure of *Turritella cingulatolineata* J. Müller (1851, p. 33, figured as *cingulatocostata*, pl. 6, fig. 15) from Aachen appears to be that of an *Ageria*, having a characteristic prominent abapical cord. Yet, the ornament shown in the figure provided by Holzapfel (1888, pl. 14, fig. 1) when he interpreted Müller's species as belonging to the genus *Mesostoma*, is quite unlike that of *Ageria*. This figure shows a median row of prominent tubercles, while its quadrangular aperture hints at the presence of a strong abapical cord.

Ageria gaultina sp. nov.

(Pl. 8, figs 1-5)

DIAGNOSIS. Narrow, turriculate shell, ornamented by orthocline axial ribs which do not persist on later whorls; its strong abapical cord is carinate.

HOLOTYPE. BM(NH) GG 6473 Albion, Gault, Folkestone, Kent. J. S. Gardner Collection.

OTHER MATERIAL. BM(NH) G 4362 (26 specimens), G 11318, G 11544, G 20741-20742, GG 20857-20862, 38085 (2), 48136 (3), Albion, Gault, Folkestone. G 71026, Gault, East Wear Bay, nr. Folkestone, Kent and G 49804, Albion, Osmington, Dorset.

Dr H. G. Owen of the Dept. of Palaeontology, BM(NH) considers that the matrix of GG 20742 is consistent with that of Bed V of the Lower Gault at Folkestone, in the *Lautus-Nitidus* Subzone.

DESCRIPTION. Small to medium-sized, turriculate shell, with an acute spire composed of moderately high whorls (height equal to $\frac{3}{4}$ of width). Flush, linear suture. Whorl outline slightly convex but briefly becoming concave before an abapical peripheral carina.

Whorls ornamented by nine orthocline axial ribs, that are crossed by numerous beaded spiral cords (22 from adapical suture to the peripheral carina in the holotype), with the interspaces separating the ribs equal to twice the width of a rib. These axial ribs are successively displaced from whorl to whorl and this produces a counter spiral pattern in relation to the direction of coiling (see pl. 8).

Such ornament occurs in the earliest whorls, but initially the orthocline ribs are much stronger than the simple spiral cords and therefore, in cross section, the whorls are angular. The basal beaded spiral is the first to become differentiated with other cords soon developing and varying in strength and composition. A pattern of five strongly beaded primary cords with a varying number of more finely beaded secondary cords occurring in their interspaces is formed. In some cords the beads are rounded, in others they become elongated in the direction of the growth lines, while the 'beads'

of some secondary cords are the result of the growth lines simply dissecting the cord. As the ornament of the spirals strengthens, the ribs tend to diminish and are almost obsolete on later whorls, where they are only indicated by the presence of strong tubercles on the primary cords. The opisthocline growth lines influence the spiral cords, but do not affect the direction of the axial ribs.

The base is delimited by the prominent basal spiral cord and this is followed inwards by a second, less prominent, primary cord, the base then slopes uniformly to the columella. The remainder of the surface is ornamented by alternating granulose spiral cords and smooth spiral threads. After crossing the basal carina, the growth lines swing sharply back towards the columella.

Unfortunately, a completely preserved aperture is not available, but it is probably somewhat quadrangular and axially elongate. There are some indications of a short anterior canal but this may have resulted from crushing of the shell. The outer lip is virtually straight in cross section, but the growth lines show a slight median sinus. The inner lip is smooth, partly callused and rather narrow. The columella is very slightly curved, but this could also be a result of crushing.

DISCUSSION. There is a little variation within the ornament of this species. A specimen of 5 whorls, found at Osmington, Dorset, BM(NH) G 49804 (see pl. 8, fig. 5) has only thirteen spiral cords between the adapical suture and the basal carina and not one of these cords is beaded, yet it does show a typical sequence of primary cords. Among ornament variations shown by material collected from the Gault of Folkestone, Kent are more equidistant primary cords; a less prominent peripheral beaded carina; broader (i.e. thicker) spiral cords ornamenting the base and a considerable range of differences in the strength and dominance of both spiral and axial elements on the early whorls (see pl. 8, figs 2, 3, 4 & 6, BM(NH) GG 20741-20742, GG 20857, GG 20862).

Ageria gaultina is easily distinguished from *A. costata* (J. de C. Sowerby), described below, by its orthocline axial ribs and the fact that these ribs do not persist on to later whorls. Its more carinate abapical cord also serves to identify the species.

The specimen figured as *Cerithium binodosum* Roemer, by Frič (1894, text-fig. 87), from the Lower Senonian, Březno Beds (Priesener Schichten) of Selten, nr. Louny, N. W. Bohemia, Czechoslovakia, is not like any other specimen figured as *C. binodosum* Roemer, 1841 and undoubtedly belongs to the genus *Ageria*. It possesses the distinctive, strongly ornamented abapical spiral cord of that genus and has very similar whorl and apertural shapes. The cancellate pattern formed by its axial ribs and spiral cords separates it from other species of *Ageria*.

Cryptaulax angustatum (d'Orbigny), Peron (1900 : 93, pl. 1, fig. 14) from the Neocomian of France, is probably another species of *Ageria*. The ornament, whorl shape, axially elongated quadrangular aperture, and smooth, slightly curved columella, are features in common with other members of that genus. Yet, its aligned (initially orthocline) prosocline axial ribs are also strongly reminiscent of the genus *Cryptaulax* Tate, 1869. The apparent lack of a strong abapical cord adds to the uncertainty, while its smooth spiral cords would readily distinguish it from the recognized species of *Ageria*. All of these features are discernible in the figures

provided by both d'Orbigny (1842, pl. 151, figs 4 & 6) and Peron, and in a British Neocomian specimen BM(NH) GG 20740, from the Claxby Beds, Nettleton, Lincs. (see pl. 8, fig. 13).

Ageria costata (J. de C. Sowerby)

(Pl. 8, figs 7-12)

1827 *Turritella costata* J. de C. Sowerby: 126, pl. 565, fig. 4.

1900 *Turritella costata* Sow., Jukes-Browne: 464.

DIAGNOSIS. Acicular shell with persistent prosocline axial ribs and a shelf-like abapical cord.

HOLOTYPE. BM(NH) 43674, Albion, Upper Greensand, Blackdown, Devon, Sowerby Collection.

OTHER MATERIAL. BM(NH) 34844 (2 specimens), G 20830-20832, G 71382, G 16142 (2 specimens) from Upper Greensand, Blackdown, Devon; G 71090-71095, from Bed 12 Peak Hill, nr. Sidmouth, Devon, H. F. Metcalfe Collection.

DESCRIPTION. A small, slender, somewhat subulate shell with convex whorls that appear to be twice their height in width. Flush, undulating suture occurs in a very slight groove beneath the abapical astragal. The whorl outline becomes concave just before this astragal and causes a small constriction in its shape. The growth lines are opisthocline and show a definite median sinus.

The shell is characteristically ornamented by a consistent pattern of axial ribs and spiral cords. Initially, the eight, or ten ribs are orthocline and dominate the ornament. However, the ribs soon become prosocline and terminate above the basal astragal as described by Sowerby. The spiral ornament consists of four to five beaded to tuberculate primary cords with both weaker beaded cords and smooth threads between these. The peripheral carina, or astragal, is shelf-like and dissected by numerous growth lines. The flattish base is ornamented by rather broader spiral cords than those of the whorl side. A strong cord, just in from the carina, forms the main feature.

The aperture (see pl. 8, fig. 9) is quadrangular and elongated axially, with a notch in the outer lip just above the astragal. The parietal lip is quite thin and the columella is not callused. The base of the aperture is flat and an anterior canal is not apparent.

DISCUSSION. Although this species is very similar to *Ageria gaultina* sp. nov. in ornament, there are a number of differences between them. The orientation of its axial ribs is markedly prosocline as opposed to the orthocline ribs of *gaultina*. A further contrast is that in *costata* the ribs persist and occur on later whorls. The shell also appears to be more needle-like in shape, even though its whorl diameter: whorl height ratio seems lower than that of *A. gaultina*. The whorls of *costata* are more convex, while the abapical astragal that delimits the base of the two species, is shelf-like in *costata* and carinate in *gaultina*.

Family **CERITHIOPSIDAE**Genus **CERITHIELLA** Verrill, 1882

[*Lovenella* Sars, 1878, non Hincks, 1869; *Newtonia* Cossmann, 1892, non Schlegel, 1866; *Newtoniella* Cossmann, 1893; *Cerithiolinum* Locard, 1903].

Type by original designation, *Cerithium metula*, Lovèn, 1846, Recent.

REMARKS. Wrigley (1940 : 13) considered that *Cerithiella* has a moderately deep sunken suture and that its subordinate axial riblets cross the spiral carinae frequently producing nodes at the intersections. In his view, the related genus *Seila* has an inconspicuous suture, is composed of essentially flat-sided whorls and its fine axial threads are only visible in the interspaces between the spirals. However, in instances where species have ornamental features similar to those of *Seila*, the truncate concave columella and short twisted anterior canal of *Cerithiella* is easily distinguishable from the virtually straight columella occurring in *Seila*. The aperture of *Cerithiella* has been described as sub-quadrangular as opposed to the sub-ovate shape found in *Seila*.

The Cretaceous species mentioned in the discussion below, were originally assigned to the genus by Sohl (1964 : 364).

***Cerithiella (Cerithiella) devonica* sp. nov.**

(Pl. 6, fig. 9)

MATERIAL. Unique specimen in the Sedgwick Museum, Cambridge, B 44633 from the Upper Albian, Blackdown, Devon.

DIAGNOSIS. Acuminate cerithiopsid with cancellate ornament consisting of three equally-spaced tuberculate spiral ribbons and numerous fine axial threads and possessing a short twisted anterior canal.

DIMENSIONS. Height = 11 mm; Maximum diameter 3 mm.

DESCRIPTION. Small slender shell with turriculate spire. Whorls almost flat-sided and with a very slight adapical ramp. Linear suture in moderately-deep asymmetric channel formed by adjacent whorls. Ornament consists of three equally-spaced spiral ribbons, the adapical ribbon being very slightly weaker. Very faint spiral threads occur on the short ramp below the adapical suture. The concave interspaces are equal to the width of the spirals. The fine axial threads are slightly opisthocline and produce angular tubercles where they cross the spiral ribbons. Ornament of the thirteen preserved whorls is consistent. The basal ornament, growth lines and protoconch are not adequately preserved for description. The aperture is incomplete but there are indications of a short twisted anterior canal.

DISCUSSION. The characters of ornament, whorl shape, suture and aperture appear to be sufficient to indicate that this specimen belongs to the genus *Cerithiella*. Its cancellate ornament of three spirals and numerous axial threads is very close to that of the North American Upper Cretaceous species *C. nodoliratum* (Wade), 1926. On comparison with the figures given by Sohl (1960; pl. 9, figs 15-16, 24) only a

slightly longer anterior canal in *nodoliratum* and the presence of the fine spirals on the short adapical ramp of *devonica* could be used as distinguishing features. Yet, these small differences when considered together with the widely separate geographical and stratigraphical occurrence of the two forms would seem to support the belief that they are distinct species. Unfortunately, the basal ornament of the British specimen is not preserved and consequently, it is not possible to verify the distinctive growth line pattern on the base of the shell, described by Sohl (1964 : 365) for the American cerithiopsids.

C. semirugatum (Wade) 1926 and *Cerithiella* sp. nov. Sohl, 1964 are easily distinguished from *C. devonica* by their ornament of four spiral ribbons. Similarly, the ornament of four variable cords in *Cerithium bicostatum* Kaunhowen (1898 : pl. 6, fig. 17) from the Maastrichtian of Belgium, separates that species from *devonica*. Kaunhowen also mentions a short, but straight canal, in his description.

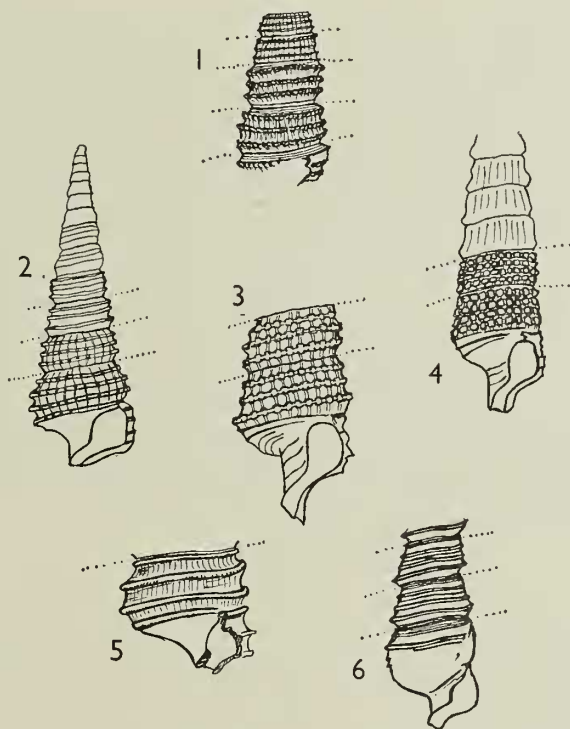


FIG. 2. 1, *Cerithiella devonica* sp. nov., Cretaceous, Upper Greensand, Albian, Blackdown. Devon. $\times 4$. 2, *Cerithiella metula* (Lovén). Type species. Recent, North Sea. $\times 2.6$. 3, *Cerithiella nodoliratum* Wade, Cretaceous, Maastrichtian, Ripley Formation. Tennessee, U.S.A. $\times 5$. 4, *Cerithiella semirugatum* Wade, Cretaceous, Maastr., Ripley Formation, Tennessee. U.S.A. $\times 4.6$. 5, *Cerithiella cloacina* Wrigley, Eocene, London Clay, Whitton, Middx., England. $\times 5$. 6, *Cerithiella atherfieldensis* sp. nov., Cretaceous, Lower Greensand, Aptian, Atherfield, Isle of Wight. $\times 2$.

The more turreted character of the Lower Aptian, *Cerithiella atherfieldensis* sp. nov. described below, together with the variation in strength of its spiral cords, its sub-carinate whorls and limited axial ornament provide distinguishing characters. In some Tertiary examples of the genus, *C. cloacina* Wrigley and *C. praelonga* (Deshayes) the spiral cords are smooth. [Text-fig. 2]

Cerithiella (Cerithiella) atherfieldensis sp. nov.

(Pl. 6, fig. 10)

HOLOTYPE. Sedgwick Museum, Cambridge B 27334 from the Lower Aptian, Forbesi Zone, Crackers, Lower Greensand, Atherfield, Isle of Wight.

DIAGNOSIS. Narrow, turreted shell, ornamented by five spiral cords of varying strength (the fourth producing a slight carination before the grooved suture) and limited axial threads.

DESCRIPTION. Small, acutely spiral turreted shell of slightly convex, sub-carinate whorls. Distinct suture in narrow groove. Protoconch not preserved. Aperture sub-ovate with a strongly twisted anterior canal; short truncated columella. Shell ornamented by five, more or less equidistant primary spiral cords and fine axial threads. A cord occurs on either side of the suture with three stronger ones in the centre of the whorl. The more abapical of these is the strongest and almost forms a carina. The interspaces are much wider than the width of the cords and a fine secondary spiral cord occurs in each of the two central interspaces. On the base, a prominent interspace separates numerous fine spiral cords from the most abapical primary cord. The fine axial threads are slightly opisthocyt on the whorl side and are not visible on the base. These axial threads are more prominent on the earlier whorls but always weaker than the spiral cords.

DISCUSSION. In this species, the small spiral angle, the limited axial ornament, the somewhat turreted appearance, the variation in strength of its spiral cords, and the abapical carination of the whorls, all serve to distinguish *C. atherfieldensis* from the other Cretaceous species mentioned in the discussion of *C. devonica*. It is also the earliest recorded species of this genus.

Genus *SEILA* Adams, 1861

[*Cinctella* Monterosato, 1884]

Type by subsequent designation, Dall (1889 : 250), *Triphoris dextroversus* Adams & Reeve, 1848, Recent.

DIAGNOSIS. (After Sohl, 1960 : 84 and 1964 : 364). Moderately small to very small, slender, turriculate, thin shell. Smooth, swollen, paucispiral protoconch. Whorls flat-sided and ornamented by prominent, smooth spiral, ribbon-like cords with numerous fine growth-line threads in their interspaces. Indistinct suture. Last whorl moderately high and with a carina at basal periphery. Aperture subovate, short anterior canal with a swelling on base of almost straight columellar lip. Outer lip thin.

Seila iglali sp. nov.

(Pl. 6, fig. 11)

MATERIAL. Unique specimen, BM(NH) G 16084, from the Upper Greensand, Albian, Combe Raleigh Hill, nr. Honiton, Devon, W. Vicary Collection.

DIAGNOSIS. Conical shell, large for genus, ornamented by four raised, flat-topped spiral ribbons on whorl side and numerous smooth spiral cords on base, with transverse threads occurring in the interspaces.

DESCRIPTION. Small, conical shell (Height: 13.5 mm; Maximum diameter: 4.8 mm) with a flat-sided whorl outline. Whorls ornamented by raised, flat-topped spiral cords (i.e. 'ribbons') with fine transverse threads in the concave interspaces between these. Distinct linear suture occurs in a symmetrical groove between adjacent whorls.

Early whorls appear to be smooth and rather convex (although this may be the result of poor preservation). Traces of axial ornament can be seen adapically on the fourth whorl, while the fifth shows faintly the typical ornament of subsequent whorls. This consists of four prominent flat spiral ribbons that are approximately equal in width but vary in their distance apart (see Text-fig. 5). The fourth ribbon is slightly narrower and forms a basal carina. The concave interspaces are crossed by regularly-spaced, easily visible, axial threads. Interspaces roughly three times the width of a thread. Axial threads essentially orthocline, but towards the base, i.e. between the third and fourth spiral ribbons, and particularly on later whorls, they tend to become opisthocline. On close examination, it is possible to see that the axial threads cross over the spiral ribbons.

Within the basal carina, and after a further concave interspace, the flat surface of the base is ornamented by numerous (15-16) identical smooth spiral cords that continue on to the columella and are separated by intervals equal to their width. Growth lines are not visible on the base.

Aperture small and sub-ovate; columella broad and equal to one third of the whorl diameter, and is twisted anteriorly. Anterior canal short and narrow.

DISCUSSION. The general flat whorl outline, together with its ornament of raised, ribbon-like spirals, leads one to consider this species as a member of the genus *Seila*. However, its size, which is greater than that of most species assigned to this genus, and its distinct linear suture, cause some uncertainty. In addition to these doubtful features, its conical shell shape is also rather unusual and quite unlike the slender, sub-cylindrical form of the type species *Seila dextroversa* (Adams & Reeve). In a number of Recent species of the genus, the base of the anterior canal forms a slit, which extends for one third of the whorl's circumference. This feature is certainly lacking in *S. iglali* and while this could be due to poor preservation, it also appears to be lacking in North American Upper Cretaceous species which suggests that it is not present in these earlier forms. Obviously, in order to confirm that this Albian fossil is correctly assigned to the genus *Seila*, it is necessary to obtain a well-preserved protoconch.

Sohl (1960 : 84) refers the North American, Upper Cretaceous species *Cerithiopsis*

meeki (Wade, 1926) and *Cerithiopsis quadrilirata* (Wade, 1926) found in the Ripley Formation (Maestrichtian), to the genus *Seila*, on the basis of their ornament and protoconch features. Since the columella fold found in both of these species is much stronger than in typical *Seila*, and, in fact, more reminiscent of other Cerithiopsidae, he qualifies this decision. Yet, as none of these genera possess ornament similar to that of *meeki* and *quadrilirata*, he refers the two species to *Seila*.

Seila iglali is very close to *S. meeki* (Wade) and apart from their considerable difference in size, the only feature that will separate the two species is the presence of a fourth spiral ribbon in *iglali*. In both *Seila quadrilirata* (Wade) and *Seila* sp. Sohl, (1960 : 85, pl. 9, fig. 23), some of the spiral ribbons are very close together. Among other distinguishing features, the axial threads of *S. quadrilirata* are finer and more numerous and also described as being prosocline; while in *Seila* sp. no. axial threads are present. Sohl (1964 : 364) has also recorded *S. meeki* from a slightly older horizon in the Upper Cretaceous [Coffee Sands of Mississippi (Campanian)] and noted that its spiral ribbons were much thinner and consequently farther apart. The limited amount of material available, prevented him from considering the possible significance in this.

Among Eocene species, *Seila mundula* (Deshayes, 1865 : 222) is the closest to *iglali*, but can be separated by its convex base and very much finer axial threads. In contrast, to the Cretaceous specimens referred to ?*Cerithiella*, there is no indication of secondary spirals developing in the interspaces of the primary ribbons in *S. iglali*.

If the determination of this specimen is correct, it will be the earliest record of the genus.

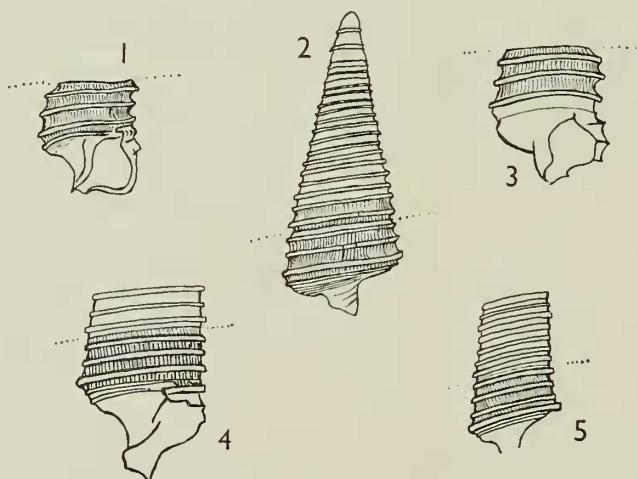


FIG. 3. 1, *Seila dextroversa* (Adams & Reeve), type species of genus. Recent. China Seas. $\times 9$. 2, *Seila iglali* sp. nov., Cretaceous, Albion, Devon, England. $\times 2.6$. 3, *Seila mundula* (Deshayes), Eocene, London Clay. Highgate. $\times 3.3$. 4, *Seila meeki* (Wade), Cretaceous, Maestrichtian. U.S.A. $\times 5$ approx. 5, *Seila quadrilirata* (Wade) Cretaceous, Maestrichtian, U.S.A. $\times 3.3$ approx.

Genus *ORTHOCHETUS* Cossmann, 1889

TYPE SPECIES. By original designation, *Cerithium leufroyi* Michelin in Deshayes, (1833 : 380), Lutetian, France.

DIAGNOSIS. (After Wenz, 1940 : 779). Medium-sized, slender, turriculate regularly conical shell, composed of numerous low whorls that have an abapical keel. Whorls ornamented by spiral cords and axial riblets, frequently producing a reticulate network. Last whorl approximately one third of shell height. Aperture subquadrangular, with a strong, moderately long, truncated canal; thin outer wall, slightly sinuous adapically. Columella straight, with base a little twisted; may be smooth, or with several oblique folds. Growth lines opisthocline to opisthocyrt, but swing back towards the columella on the base.

Orthochetus hantoniensis sp. nov.

(Pl. 6, fig. 12)

MATERIAL. BM(NH) G 70130, Aptian, Atherfield, Isle of Wight.

DIAGNOSIS. Slender, turreted cerithiopsid with an abapical carina and strongly developed axial ribs (fewer in number than normal), which influence five of the six spiral cords to produce a frilled appearance. Columella straight, but uncharacteristically short and apparently without plications.

DESCRIPTION. Small, slender, turreted shell with fairly low whorls. The suture is subcarinate and linear, but axial ribs may give it an undulate appearance. The protoconch is not completely preserved, but early ornament seems to be identical to that of later whorls. This ornament consists of strong, straight axial ribs (15-16 per whorl) that are separated by interspaces equal to their width; and six spiral cords of varying strength. A slight adapical ramp occurs immediately beneath the suture and this is bounded by a strong spiral cord. At equal distances below this follows a very weak cord, a moderately strong cord, then at the abapical carina another strong cord, and, finally, another weak cord.

All of these five cords are influenced by the axial ribs, the apparent thickening at their intersections producing a frilled, or tuberculate appearance to the shell. A sixth spiral cord close to the abapical suture, limits the base and is unaffected by the axial ribs. The axial ribs diminish soon after the abapical carina.

Numerous faint opisthocline growth lines occur on the whorl side and on the base these swing back towards the columella. Columella moderately short and straight with faint oblique ornament along its length. Small aperture subquadrangular, showing a well-developed, twisted and truncated anterior canal. Thin sinuous outer lip.

DISCUSSION. The distinctive ornament and slender turreted spire of this species, together with its general apertural features, are sufficient to refer it to the genus *Orthochetus*. However, the columella is somewhat shorter than is usual, while its twisted anterior canal is less inclined; in fact, such features are reminiscent of the genus *Cerithiella*. The strongly developed axial ornament and its consequent

influence on the shell's appearance are adequate diagnostic features to separate this species from others that have been described. The lack of plications on the columella might be construed as uncharacteristic of *Orthochetus*, yet, Wrigley (1940 : 11 & 12) mentioned a number of instances in Eocene species where this feature is obscured by a reflected columella border.

Its diagnostic features distinguish *O. hantoniensis* from the two Maastrichtian species mentioned by Cossmann (1906 : 97) *Cerithium tectiforme* Binkhorst (1861 : 24 pl. 1 figs 3a-c) from Limbourg and *O. mapeulensis* Douvillé (1904 : 303 pl. 41 fig. 12) from Kouh Mapeul, Persia. The ornament of both these Maastrichtian species is more reticulate, due to the presence of smaller and more numerous axial ribs. Although both *O. hantoniensis* and *O. tectiformis* have three primary spiral cords, the presence of secondary spirals in the former and of tubercles in the latter assist in separating the two species.

Douvillé (1904 : 303) referred to *Orthochetus* as an ancient group and quoted the occurrence in the Chalk of *Cerithium cribriforme* Zekeli (1852 : pl. 20, figs 2 & 2') as evidence. In many respects, this turreted species is very like *O. hantoniensis*,

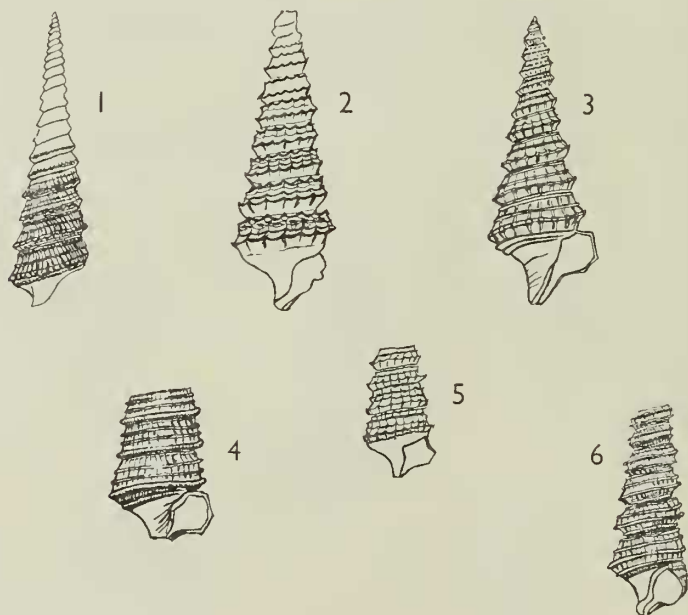


FIG. 4. 1, *Orthochetus tectiformis* (Binkhorst), Cretaceous, (Maastrichtian), Limbourg Netherlands. $\times 1.3$. 2, *Orthochetus hantoniensis* sp. nov., Cretaceous (Aptian). Atherfield, Isle of Wight. $\times 3.3$. 3, *Orthochetus leufroyi*; (Michelin in Deshayes 1833). Eocene. Chaumont, France. Type species. $\times 0.6$. 4, *Orthochetus charlesworthi* (Prestwich), Eocene, London Clay. Sheppey, Kent. $\times 0.6$. 5, *Orthochetus mapeulensis* Douville. Cretaceous, (Maastrichtian). Louristan, S. Persia. $\times 1.3$. 6, *Orthochetus elongatus* Wrigley. Eocene, London Clay, Sheppey. $\times 0.6$.

having strong axial ribs and three smooth spiral cords undulating over them. Yet its aperture is not shown, and there are no indications of secondary spirals in the figure which does show that *C. cribriforme* is rather awl-shaped, i.e. subulate. The existence of *O. hantoniensis* would appear to substantiate Douville's claim that the genus *Orthochetus* arose in the Cretaceous, even if *C. cribriforme* Zekeli should prove to be mis-identified.

Several of the larger Eocene species show that the anterior canal and the columella are not necessarily identical to, or as long as that of the type species *O. leufroyi*. Comparison of *O. charlesworthi* (Prestwich) and *O. elongatus* Wrigley illustrates that there is considerable variation in spiral angle and whorl diameter. Wrigley (1940 : 12) also showed that within a species there is a wide variation in the strength and position of its ornament components, e.g. see his figures of *O. elongatus* (p. 17, figs 13-15).

Incertae sedis

? '*Orthochetus*' *helmyi* sp. nov.

(Pl. 6, figs 13 & 14)

MATERIAL. BM(NH) G 10500 and G 71988 from the Gault, Albion of Folkestone, Kent.

DIAGNOSIS. Turreted, conical cerithiopsid, ornamented by four prominent flat-topped ribbon-like spiral cords and numerous fine opisthocyrt axial threads.

DESCRIPTION. Medium-sized, slightly turreted, conical shell. Distinct linear suture lies in a furrow between the abapical and adapical primary spiral cords of adjacent whorls. Protoconch not preserved.

Whorl side ornamented by four strong, prominent, flat, ribbon-like spiral cords, with a fifth weaker primary cord occurring at the abapical suture and delimiting the base. The two lower ribbons, i.e. the third and fourth abapically, are stronger and wider. Secondary spiral threads occur in the unequal interspaces between the primary ribbons, but can only be seen easily on the lower halves of later whorls. Fine axial growth threads occur in the interspaces and also continue over the spiral ribbons. These opisthocyrt threads show a broad shallow sinus, which has its apex at mid-whorl; each thread is separated from its neighbour by a space equal to double the width of a thread.

The base is flat to feebly convex and within the delimiting fifth primary cord, it is ornamented by numerous thin secondary spirals. The opisthocyrt growth lines, after crossing on to the base, tend to straighten and then swing back towards the columella. The aperture is sub-quadrangular and has a flat basal lip. The short columella is smooth.

DISCUSSION. It is difficult to assign this species to one particular genus of the Cerithiopsidae without having a specimen that shows the important details of its aperture and protoconch, for its ornament and whorl shape have characteristics similar to those of *Cerithiella*, *Seila* and *Orthochetus*. Reference to the literature and to collections of Tertiary representatives of these genera does not provide any

useful guide, since it is apparent that there is some confusion in distinguishing the genera and in assigning species to them. The criteria that Wrigley (1940 : 13) used, have been referred to under *Cerithiella* (page 160), but these are often inadequate, e.g. the inconspicuous suture that is considered a diagnostic feature of the genus *Seila*. Undoubtedly, a reappraisal of the criteria used to distinguish the genera of the Cerithiopsidae is necessary and the review of species assignments suggested by Sohl could be undertaken at the same time.

Some of the features present in '*helmyi*', i.e. the distinct linear suture and the crossing of the spirals by the axial threads, indicate possible affinities with *Cerithiella*. The moderate size of the specimen and the fact that its whorls could hardly be described as flat-sided, indicate that it should not be assigned to *Seila*, but could easily be recognized as a possible member of *Orthochetus*. The presence of prominent, ribbon-like spiral cords and the fine axial opisthocyrt threads and the basal features of the whorl, together with the indications of a short straight columella are reminiscent of several species of *Seila*, including the type species *S. dextroversa*. However, these features could equally be those of *Orthochetus* and therefore after recognizing that the linear suture is very like that of Eocene species of this genus, *helmyi* is provisionally placed in *Orthochetus*. In the majority of described species of this genus, and particularly in the earliest member *O. hantoniensis*, the axial ornament is quite prominent and contributes to the typical reticulate ornament pattern. The size, ribbon-like spirals, super-imposed axial ribs and turreted whorl shape of *helmyi* are considered to be the most important indicators of its probable relationship with *Orthochetus*.

Similar difficulties prevent the assignment of a unique specimen, preserved as an external mould in an ironstone concretion from the Sandgate Beds, found at Parham Park, Sussex (BM(NH) 9145, G. A. Mantell Collection, (see pl. 6, fig. 15).

The ornament of this medium-sized, turreted gastropod consists of three primary and three secondary spiral cords. It has a distinct linear, impressed suture and opisthocyrt growth lines between the sutures. The whorls are not flat-sided, (in fact they are concavo-convex) and the spiral cords are carinate, or rounded, not 'ribbon-like'. Axial ornament, apart from the collabral threads, is lacking. A slight distortion in the smooth opisthocyrt curve wherever the growth line crosses a spiral cord produces a wavy effect. Unfortunately, neither the abapical portion of the body whorl, nor the aperture are preserved.

VI. CONCLUSIONS

The need for exhaustive re-examination and re-evaluation of existing collections and type material has been repeatedly mentioned in the discussion above and can only be emphasized again here. Before the taxonomy of the Cerithiacea can be revised, it is necessary to improve upon the incomplete information currently available by collecting additional material. Admittedly the task of revision is complicated by the limitations of the characters that are used to distinguish fossil gastropods, while their poor preservation adds to this difficulty. Yet, the careful collecting advocated by present-day palaeontologists should enable these problems

to be surmounted. The important morphological and ornamental variation of Cretaceous gastropods can be satisfactorily assessed, once accurate information on their stratigraphical occurrence is produced. These conclusions would then contribute to and facilitate our understanding of their phylogenetic and palaeoecological relationships.

The family Cerithiidae became conspicuous during the Cretaceous and during that period experimented with the form of the aperture and anterior canal. Fossil evidence is sparse and consequently, our knowledge of the forms which are thought to be transitional between either the Procerithiidae, or the more cerithiid-like Eustomidae, and true cerithiids is very limited. A similar situation occurs with their descendants. In order to achieve a re-assessment of these families, a full understanding of the derivation of the anterior canal is vital. Critical genera such as *Ageria*, *Cimolithium* and *Uchauxia* require further investigation, and determination of the phylogenetic position of *Metacerithium*, *Exechocirsus* and *Campanile* is equally important. Cox (1965 : 158) briefly mentioned the possibility that difficult groups might prove to be polyphyletic (he referred to this while discussing the origin of *Exelissa*, a genus of the Procerithiidae), but did not proceed to discuss the taxonomic implications of such a suggestion. It would provide an easy explanation of the morphological diversity apparent in '*Rhabdocolpus*' but careful consideration is necessary before such a theory can be followed.

The variation in ornament shown by several of the Cretaceous gastropods discussed here, is not thoroughly understood. In some genera, e.g. *Metacerithium*, ornament is said to be basically stable, while in others, e.g. *Bathraspira* it would appear to alter very quickly. Further, the significance of sculptural variation within a species, such as that shown by *Exechocirsus saundersi* (Woods), is also not fully appreciated. It has been suggested that the smaller Yorkshire specimens of this species might be explained as an example of ecotypic variation. The results of the detailed study recommended above should assist in providing an answer to these questions.

Among more detailed points for consideration is the verification and explanation of the occurrence of several species of the same genus at a particular horizon, e.g. three species of ?*Rhabdocolpus* in the Crackers Bed of the Lower Aptian in the Isle of Wight. There are also certain elements of doubt concerning the generic identification of several species that are considerably larger than the normal size of the genus to which they are assigned. In classifying Cretaceous gastropods 'size' is frequently used as a guide, in a subconscious and perhaps, quite illogical manner. If some disparity occurs, the correctness of the determination begins to be doubted. This is certainly true for the Upper Cretaceous specimens of *Nerineopsis* described in the paper and also for the Upper Albian species *Seila iglali*.

A better understanding of the relationship of Tertiary and Recent gastropods is to a large extent dependent upon earlier forms. The origin and early evolution of many Recent prosobranch families occurred during the Cretaceous period and the past neglect and inadequate descriptions of gastropods of this age needs to be remedied.

It is hoped that this paper will provide some of the preliminary data necessary for

a more detailed and sophisticated appraisal of Cretaceous gastropods, and also that it will serve to pose a few of the questions needing investigation before such a study can be undertaken.

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